Appendix A: Wyoming Coal Rules and Regulations, Chapter IV

CHAPTER 4

ENVIRONMENTAL PROTECTION PERFORMANCE STANDARDS

FOR SURFACE COAL MINING OPERATIONS

Section 1. **General.**

This Chapter sets forth the environmental protection performance standards applicable to all coal mining operations. No mining operation shall be conducted except in compliance with the requirements hereof.

Section 2. **General Environmental Protection Performance Standards.**

(a) Land uses.

(i) Reclamation shall restore the land to a condition equal to or greater than the "highest previous use." The land, after reclamation, must be suitable for the previous use which was of the greatest economic or social value to the community area, or must have a use which is of more economic or social value than all of the other previous uses.

(ii) Operators are required to restore wildlife habitat, whenever the Administrator determines that this restoration is possible, on affected land in a manner commensurate with or superior to habitat conditions which existed before the land became affected, unless the land is private and the proposed use is for a residential or agricultural purpose which may preclude its use as wildlife habitat.

(iii) Water impoundments used for recreational purposes shall be constructed in accordance with the statutes and (g) of this Section. Recreational lands, other than water impoundments, represent changes in the land which may or may not be suitable for wildlife habitat.

(b) Backfilling, grading and contouring.

(i) Rough backfilling and grading shall follow coal removal as contemporaneously as possible based upon the mining conditions. The operator shall include within the application for a permit to mine a proposed schedule for backfilling and grading with supporting analysis.

(ii) Backfilled materials shall be replaced in a manner which minimizes water pollution on and off the site and supports the approved postmining land use.

Preparation of final graded surfaces shall be conducted in a manner that minimizes erosion and provides a surface for replacement of topsoil that will minimize slippage.

(iii) All affected lands shall be returned to their approximate original contour, except as authorized by a variance or exemption under Chapter 5, Sections 6 and 7, or Chapter 8, or Chapter 9.

(iv) All spoil shall be transported, backfilled, compacted (where necessary to insure stability or to prevent leaching) and graded to eliminate all highwalls, spoil piles, and depressions, except that:

(A) Soil conservation techniques may be employed if they are needed to retain moisture, minimize erosion, create and enhance wildlife habitat, and assist revegetation.

(B) Incomplete elimination of highwalls may be authorized in accordance with Chapter 5, Section 7.

(C) Spoil may be placed on an area outside the mined-out area to restore the approximate original contour by blending the spoil into the surrounding terrain if the spoil is backfilled and graded on the area in accordance with the requirements of this subsection.

(v) Postmining slopes shall not exceed a slope necessary to achieve a minimum long-term static safety factor of 1.3, to prevent slides and restore stable drainages and hillslopes.

(vi) Thin overburden. Where surface coal mining operations are proposed to be carried out continuously in the same limited pit area for more than one year from the day coal removal operations begin and where the volume of all available spoil and suitable waste materials over the life of the mine is demonstrated to be insufficient to achieve the approximate original contour considering bulking factor and coal removal, surface mining activities shall be conducted to use all available spoil and suitable waste materials to attain the lowest practicable stable grade, but not more than the angle of repose, and to meet the requirements of paragraphs (ii) and (iv) above.

(vii) Thick overburden. Where the volume of spoil over the life of the mine is demonstrated to be more than sufficient to achieve the approximate original contours considering bulking factor, coal removal and subsidence of backfilled material, excess spoil may be placed outside the pit area in accordance with the requirements of subsection (c).

(viii) Permanent impoundments: Where permanent impoundments are authorized in accordance with Chapter 2, Section 2(b)(xiv), spoil that may result from the impoundment will be handled in accordance with the requirements of this subsection.

(ix) Soft rock surface mining.

(A) If the reclamation plan does not provide for a permanent water

impoundment, the final pit area shall be backfilled, graded, compacted and contoured to the extent necessary to return the land to the use specified in the approved plan. In preparation of slope specifications in the plan, the operator shall consider an average of the measured slopes in the immediate area of the proposed mine site. Slopes in the reclaimed area shall approximate the premining slopes. Individual slope measurements, locations of the measurements, and the average measurement shall be submitted with the reclamation plan. In determinations of the approximate premining slope, the Land Quality Division may make an independent slope survey. All backfilling, grading, and contouring will be done in such a manner so as to preserve the original drainage or provide for approved adequate substitutes. No depressions to accumulate water will be permitted unless approved in the reclamation plan as being consistent with the proposed future use of the land.

(B) Terraces or benches may be used only when it can be shown to the Administrator's satisfaction that other methods of contouring will not provide the required result. If terracing is proposed, detailed plans indicating the dimensions and design of the terraces, check dams, any erosion prevention techniques, and slopes of the terraces and their intervals will be required.

(C) If the reclamation plan provides for a permanent water impoundment and this use has been approved according to the requirements outlined in the Act and these regulations, the exposed pit areas must be sloped, graded, and contoured so as to blend in with the topography of the surrounding terrain and provide for access and revegetation. Riprapping where necessary to prevent erosion will be required. Sloping requirements will be as described above. Under certain conditions wherein it can be demonstrated to the Administrator's satisfaction that the pitwall can be stabilized by terracing or other techniques it may be permissible to leave not more than one-half of a proposed shoreline composed of the stabilized pitwall. The remaining portion of the shoreline must be graded and contoured so as to provide access and blend in with the topography of the surrounding terrain. In the event that a partial pitwall is proposed as final reclamation, the operator must submit a detailed explanation of the techniques to be used to establish the stability of the pitwalls in his reclamation plan. At the Administrator's discretion, a study of the proposed pitwall stabilization techniques may be required from an independent engineering company for purposes of verifying the effectiveness of the proposed stabilization techniques. The Land Quality Division will determine the acceptability of the proposed stabilization techniques based on this information and an on-site inspection.

(D) Highwall retention may be considered on a case-by-case basis for enhanced wildlife habitat. The Wyoming Game and Fish Department shall be consulted by the applicant for need and design of the land form. Any approval under this paragraph shall be based on a demonstration of safety, stability, environmental protection, and equal or better land use considerations.

(c) Topsoil, subsoil, overburden, and refuse.

(i) Topsoil.

(A) All topsoil or approved surface material shall be removed from all areas to be affected in the permit area prior to these areas being affected unless otherwise authorized by the Administrator. The topsoil may be mixed with the subsoil but shall be segregated so as not to become mixed with spoil or waste material, stockpiled in the most advantageous manner and saved for reclamation purposes. The Administrator may authorize topsoil to remain on areas where minor disturbance will occur associated with construction and installation activities including but not limited to light-use roads, signs, utility lines, fences, monitoring stations and drilling provided that the minor disturbance will not destroy the protective vegetative cover, increase erosion, nor adversely affect the soil resource.

(B) When topsoil is not promptly redistributed, the topsoil or approved surface material shall be stockpiled on stable areas within the permit area in such a manner so as to minimize wind and water erosion and unnecessary compaction. In order to accomplish this, the operator shall establish, through planting or other acceptable means, a quick growing cover of vegetation on the topsoil stockpiles. The topsoil shall also be protected from acid or toxic materials, and shall be preserved in a usable condition for sustaining vegetation when placed over affected land. Provided however, where long-term disturbance will occur, the Administrator may authorize the temporary distribution of topsoil to enhance stabilization of affected lands within the permit area. Where this is authorized, the Administrator shall find that the topsoil or subsoil capacity and productive capabilities are not diminished, that the topsoil is protected from erosion, and will be available for reclamation.

(C) Reclamation shall follow mining as soon as is feasible so as to minimize the amount of time topsoil must be stockpiled. Where topsoil has been stockpiled for more than one year, the operator may be required to conduct nutrient analyses to determine if soil amendments are necessary.

(D) Topsoil stockpiles shall be marked with a legible sign containing letters not less than six inches high on all approach roads to such stockpiles. Said signs shall contain the word "Topsoil" and shall be placed not more than 150 feet from any and all stockpiles of topsoil. Such signs must be in place at the time stockpiling is begun.

(E) If abundant topsoil is present, and it is not all needed to accomplish the reclamation required in the approved reclamation plan, the Administrator may approve of use of this topsoil by this or another operator in another area for reclamation purposes.

(F) Trees, large rocks and other waste material which may hinder redistribution of topsoil shall be separated from the topsoil before stockpiling.

(ii) Subsoil.

(A) Except as provided in (B), all subsoil determined by field methods or chemical analysis to be suitable as a plant-growth medium shall be removed from all areas to be affected and handled in accordance with the topsoil requirements of this Section.

(B) Upon an adequate demonstration by the operator that all or a portion of the subsoil material is not needed to meet the revegetation and land use requirements of these regulations, the Administrator may authorize all or a portion of the subsoil to not be used for reclamation. The unused subsoil may then be regarded as overburden material and handled in accordance with the requirements of this Section.

(iii) The topsoil (A and E horizons) shall be segregated from the subsoil (B and C horizons) where the Administrator determines that this practice is necessary to achieve the revegetation requirements of these regulations.

(iv) Before redistribution of topsoil or subsoil the regraded land shall be treated, if necessary, to reduce potential for slippage and encourage root penetration.

(v) Topsoil, subsoil, and/or an approved topsoil substitute shall be redistributed in a manner that:

(A) Achieves an approximate uniform, stable thickness consistent with the approved permit and the approved postmining land uses, contours and surface water drainage system;

(B) Prevents compaction which would inhibit water infiltration and plant growth;

(C) Protects the topsoil from wind and water erosion before and after it is seeded until vegetation has become adequately established; and

(D) Conserves soil moisture and promotes revegetation.

(vi) All rills and gullies which either preclude achievement of the approved postmining land use or the reestablishment of the vegetative cover, or cause or contribute to a violation of water quality standards for the receiving stream, shall be regraded or otherwise stabilized. Topsoil shall be replaced and the areas shall be reseeded or replanted.

(vii) Nutrients and soil amendments in the amounts determined necessary by soil test or field trials shall be applied to the replaced topsoil, subsoil or substitute material so that adequate nutrient levels are available to establish the vegetative cover. Fertilizer shall be applied at appropriate seasons and in amounts that will minimize pollution of surface waters or groundwaters.

(viii) The Administrator may not require topsoil or subsoil replacement on structures or within impoundments where replacement of this material is inconsistent with the intended use and the structures are otherwise stable.

(ix) If a sufficient volume of suitable topsoil or subsoil is not available for salvage

or redistribution, then selected spoil material may be used as a topsoil or subsoil substitute or supplement. The operator shall demonstrate that the resulting plant growth medium is equal to, or more suitable for sustaining vegetation than the existing topsoil or subsoil and that it is the best available in the permit area to support revegetation. A demonstration of the suitability of the substitutes or supplements shall be based upon analysis of the texture, percent coarse fragments and pH. The Administrator may require other chemical and physical analyses, field site trials, or greenhouse tests if determined to be necessary or desirable to demonstrate the suitability of the topsoil or subsoil substitutes or supplements.

(x) Topsoil and subsoil substitutes.

(A) Topsoil substitute stockpiles shall be segregated from topsoil and overburden piles and shall be identified as substitute material. Identification signs shall be placed not more than 150 feet from all stockpiles of substitute material. Such signs shall be in place at the time stockpiling is begun.

(B) If overburden is to be used in reclamation as a substitute for topsoil, all large rocks and other waste material which may hinder redistribution shall be separated before stockpiling.

(xi) Overburden, spoil and refuse.

(A) All overburden, spoil material and refuse shall be segregated from the topsoil and subsoil and stockpiled in such a manner to facilitate the earliest reclamation consistent with the approved reclamation plan.

(B) Except where diversions are authorized by these regulations, all overburden, spoil material, and refuse piles must be located to avoid blocking intermittent or perennial drainages and flood plains in order to minimize loss and spread of material due to water erosion. Ephemeral drainages may be blocked if environmentally sound methods for dealing with runoff control and sedimentation are approved by the Administrator.

(I) For temporary stockpiles, material should be replaced in pits as soon as possible consistent with the approved reclamation plan to minimize the amount of time material is stockpiled.

(C) All topsoil shall be removed from areas to be used for piling spoil material prior to the beginning of piling this material.

(D) The operator may be required to have analyses made of spoil material in order to determine if it will be a source of water pollution through reaction with leaching by surface water. If it is determined that this condition may exist, the operator shall describe proposed procedures for eliminating this condition.

(E) All overburden and spoil material that is determined to be toxic, acid-forming or will prevent adequate reestablishment of vegetation on the reclaimed land surface, unless such materials occur naturally on the land surface, must be properly disposed of during the mining operation.

(F) All excess spoil shall be placed in approved excess spoil disposal sites located within the permit area. If permanent overburden, spoil, or refuse piles have been approved by the Administrator, they shall be:

(I) Located on moderately sloping and naturally stable areas where placement provides for stability and prevents mass movement.

(II) Located in areas which do not contain springs, seeps, natural or man-made drainages (excluding rills and gullies), croplands, or important wildlife habitat.

(III) Designed, graded and contoured so as to blend in with the topography of the surrounding terrain. Excess spoil pile sites shall not be located on an overall slope that exceeds 20 degrees unless keyway cuts (excavations to stable bedrock), rock toe buttresses or other special structural provisions are constructed to ensure fill stability. The operator must demonstrate to the satisfaction of the Administrator that this material will be stable and can be revegetated as required by this Section.

(IV) The slopes of all spoil areas must be designed so that they will be stabilized against wind and water erosion. After the grading and contouring of these stockpiles, topsoil or approved subsoil must be distributed over them in preparation for the revegetation procedure. Revegetation must be completed in accordance with requirements of this Chapter. A permanent drainage system must be established consistent with these regulations.

(G) Excess spoil may be returned to underground mine workings in accordance with the plan approved by the Administrator and by MSHA.

(H) Excess spoil piles shall be designed using current, prudent professional standards and certified by a qualified registered professional engineer. All piles shall be designed and constructed in accordance with the standards of this subsection. Special structural provisions shall be designed using prudent current engineering practices, in accordance with Chapter 2, Section 2(b)(xviii)(E).

(I) Excess spoil shall be placed in a controlled manner to:

(I) Prevent pollution from leachate and surface runoff from the fill on surface water or groundwater of the State.

(II) Ensure mass stability and prevent mass movement during and after construction and provide for stable drainages and hillslopes.

(III) Ensure that the land mass designated as the disposal site is suitable for reclamation and revegetation compatible with the natural surroundings and approved postmining land use.

(J) The spoil pile shall be transported and placed in horizontal lifts in a controlled manner, concurrently compacted as necessary to ensure mass stability and prevent mass movement, covered, and graded to allow surface and subsurface drainage to be compatible with the natural surroundings and ensure a minimum long-term static safety factor of 1.5. The Administrator may limit the horizontal lifts to four feet or less as necessary to ensure the stability of the fill or to meet other applicable requirements.

(K) No water impoundments or large depressions shall be constructed on the fill. Soil conservation techniques may be approved if they are needed to minimize erosion, enhance wildlife habitat or assist revegetation, as long as they are not incompatible with the stability of the fill.

(L) The foundation and abutments of the fill shall be stable under all conditions of construction. Sufficient foundation investigation and any necessary laboratory testing of foundation materials shall be performed in order to determine the design requirements for foundation stability. Analyses of foundation conditions shall include the effect of underground mine workings, if any, upon the stability of the structure.

(M) Slope protection shall be provided to minimize surface erosion at the site. Diversion of surface water runoff shall conform with the requirements of subsection (e) of this Section. All disturbed areas, including diversion ditches that are not riprapped, shall be vegetated upon completion of construction.

(N) Terraces may be constructed on the outslope of the fill if required for stability, control of erosion, to conserve soil moisture, or to facilitate the approved postmining land use. The grade of the outslope between terrace benches shall not be steeper than 2h:lv (50 percent).

(O) Excess spoil that is toxic, acid-forming or combustible shall be adequately covered with suitable material or treated to prevent pollution of surface and groundwater, to prevent sustained combustion, and to minimize adverse affects on plant growth and the approved postmining land use.

(P) The Administrator may specify additional design criteria on a case-by-case basis as necessary to meet the general requirements of this subsection.

(Q) The fill shall be inspected for stability by a qualified registered professional engineer or other qualified professional specialist under the direction of a professional

engineer experienced in the construction of earth and rockfill embankments at least quarterly throughout construction and during the following critical construction periods: (1) foundation preparation, including the removal of all organic material and topsoil, (2) placement of diversion systems, (3) installation of final surface drainage systems, and (4) final grading and revegetation. Regular inspections by the engineer or specialist shall be conducted during placement and compaction of the fill materials. The registered professional engineer shall promptly provide certified reports to the Administrator which demonstrate that the fill has been maintained and constructed as specified in the design contained in the approved mining and reclamation plan. The report shall discuss appearances of instability, structural weakness, and other hazardous conditions. A copy of all inspection reports shall be retained at the mine site.

(xii) Coal mine waste.

(A) Coal mine waste shall be disposed only in existing or, if new, in an approved disposal site within a permit area. Coal mine wastes shall not be used in the construction of dams, embankments, or diversion structures. The disposal area shall be designed, constructed and maintained:

(I) In accordance with the excess spoil disposal requirements of (xi)(F)-(I), and (K)-(O) above; and

(II) To prevent combustion and not create a public health hazard.

(B) Disposal of coal mine waste in excess spoil piles may be approved if such waste is:

(I) Placed in accordance with the excess spoil requirements of (xi) above;

(II) Demonstrated to be nontoxic and nonacid-forming (or properly treated); and

(III) Demonstrated to be consistent with the design stability of the fill.

(C) In addition to (A) above, coal mine waste piles shall meet the following requirements:

(I) The disposal facility shall be designed to attain a minimum static safety factor of 1.5. The foundation and abutments must be stable under all conditions of construction.

(II) Following final grading of the waste pile, the site shall be covered with a minimum of four feet of the best available, nontoxic, nonacid-forming and

noncombustible material, in a manner that directs runoff away from the waste pile. The site shall be revegetated in accordance with this Chapter. The Administrator may allow less than four feet of cover material based on physical and chemical analyses which show that the revegetation requirements will be met.

(III) Surface drainage from above the pile and from the crest and face of the pile shall be permanently diverted around the waste in accordance with subsection (e) of this Section.

(IV) All coal mine waste piles shall be inspected in accordance with the excess spoil requirements of (xi) above. More frequent inspections shall be conducted if a danger or harm exists to the public health and safety or the environment. Inspections shall continue until the waste pile has been finally graded and revegetated or until a later time as required by the Administrator. If any inspection discloses that a potential hazard exists, the Administrator shall be notified immediately, including notification of any emergency protection and remedial procedures which will be implemented. If adequate procedures cannot be formulated or implemented, the Administrator shall inform the appropriate emergency agencies of the hazard to protect the public from the area.

(V) All coal mine waste piles shall meet the requirements of 30 CFR §§ 77.214 and 77.215.

(D) Dams and embankments constructed to impound coal mine waste shall comply with the following:

(I) Each impounding structure shall be designed, constructed and maintained in accordance with the requirements applicable to temporary impoundments. Such structures may not be retained permanently as part of the approved postmining land use. Approval by the State Engineer's Office is not required.

(II) If the impounding structure meets the criteria of 30 CFR § 77.216 (a), the combination of principal and emergency spillways shall be able to safely pass the 100-year, 6-hour design precipitation event or a storm duration having a greater peak flow.

(III) Spillways and outlet structures shall be designed to provide adequate protection against erosion and corrosion. Inlets shall be protected against blockage.

(IV) Be designed so that 90 percent or more of the water stored during the design precipitation event can be removed within ten days.

(V) Runoff from areas above the disposal facility or runoff from the surface of the facility that may cause instability or erosion of the impounding structure shall be diverted into stabilized diversion channels designed to meet the requirements for diversions, and designed to safely pass the runoff from a 100-year, 6-hour design precipitation event or a storm

duration having a greater peak flow.

(E) The Administrator may specify additional design criteria for waste piles or impounding structures on a case-by-case basis as necessary to meet the general performance standards of this subsection.

(F) Coal mine waste fires shall be extinguished by the operator in accordance with a plan approved by the Administrator and the Mine Safety and Health Administration. The plan shall contain, at a minimum, provisions to ensure that only those persons authorized by the operator, and who have an understanding of the procedures to be used, shall be involved in the extinguishing operations. No burning or burned coal mine waste may be removed from a permitted disposal area without a removal plan approved by the Administrator. Consideration shall be given to persons working or living in the vicinity of the structure.

(G) Coal preparation plants shall be included within a permit area. Refer to Chapter 3, Section 6 for requirements applicable to coal preparation plants.

(xiii) Acid-forming and toxic materials, and other waste.

(A) All exposed coal seams remaining after mining and any acid-forming, toxic, and combustible materials, or any waste materials that are exposed, used or produced during mining shall be adequately covered, within 30 days of its exposure with nontoxic, nonacid-forming and noncombustible material, or treated. Compaction followed by burial or treatment shall be provided to prevent pollution of surface and groundwater quality, prevent sustained combustion and to minimize adverse effects on plant growth and postmining land uses. Such materials may be stored in a controlled manner until final burial and/or treatment first becomes feasible as long as storage will not result in any risk of water pollution or other environmental or public health and safety damage. Storage, final burial and treatment shall be done in accordance with all local, State and Federal requirements.

(B) Acid-forming or toxic material, or any other waste material capable of polluting water, shall not be buried or stored in the proximity of a drainage channel or its flood plain so as to cause or pose a threat of water pollution.

(C) Final burial of noncoal mine waste materials (such as grease, lubricants, paints, flammable liquids, garbage, trash, abandoned mining machinery, lumber and other combustible materials) and any wastes classified as hazardous shall be in a designated disposal site authorized by the Solid Waste Management Section of the Department.

(D) Management and final burial on the permit area of solid wastes generated by a mine mouth power plant or mine mouth coal drier shall be in accordance with this Section and with provisions of the Solid Waste Management Rules and Regulations deemed appropriate by the Administrator.

(d) Revegetation.

(i) The operator shall establish on all affected lands a diverse, permanent vegetative cover of the same seasonal variety native to the area or a mixture of species that will support the approved postmining land use in a manner consistent with the approved reclamation plan. This cover shall be self-renewing and capable of stabilizing the soil.

(ii) Land which did not support vegetation prior to becoming affected land because of natural soil conditions need not be revegetated unless subsoil from such affected land will support vegetation. The operator shall demonstrate to the Administrator's satisfaction that revegetation or reforestation is not possible if he seeks to proceed under the provisions of the subsection.

(iii) After backfilling, grading, and contouring and the replacement of topsoil, and/or approved substitutes, revegetation shall be commenced in such a manner so as to most efficiently accommodate the retention of moisture and control erosion on all affected lands to be revegetated. In addition, any fertilizer requirements as determined on the basis of previous analysis must be fulfilled.

(iv) Mulch or other equivalent procedures which will control erosion and enhance soil moisture conditions shall be used on all retopsoiled areas.

(v) Seeding which is accomplished by mechanical drilling shall be on the topographic contour, unless for safety reasons it is not practicable, or perpendicular to the prevailing wind on flat areas. Seeding of affected lands shall be conducted during the first normal period for favorable planting conditions after final preparation unless an alternative plan is approved. Any rills or gullies that would preclude successful establishment of vegetation or achievement of postmining land use shall be removed or stabilized. The species of vegetation to be used in revegetation efforts shall be described in the reclamation plan indicating the composition of seed mixtures and the amount of seed to be distributed on the area on a per acre basis. Seed types will depend on the climatic and soil conditions prevailing in the permit area and the proposed use of the land after reclamation. Species to be planted as permanent cover shall be self-renewing. Seeding rates will depend on seed types, climatic and soil conditions and the techniques to be used in seeding.

(vi) Introduced species may be used only to achieve a quick, temporary, stabilizing cover to control erosion, or to achieve a postmining land use as approved by the Administrator. Naturalized or nonindigenous native plant species may be included in the approved seed mixture if they support the approved postmining land uses. The operator shall document, unless otherwise authorized by the Administrator, the suitability of these species using data from published literature, from experimental test plots, from on-site experience, or from other information sources.

(vii) When the approved postmining land use is for residential, industrial/commercial, or cropland, the reclaimed area shall be stabilized and revegetated to control

erosion unless development or cropping shall immediately occur.

(viii) For areas previously disturbed by mining and not reclaimed to the requirements of these regulations, the areas shall, at a minimum, be revegetated to a ground cover and productivity level existing before redisturbance and shall be adequate to control erosion.

(ix) Bond release. The bond for revegetation shall be retained for not less than ten years after the operator has completed seeding, fertilizing, irrigation, or other work to ensure revegetation. The bonding period shall not be affected where normal and reasonably good husbandry practices are being followed. The success of revegetation shall be determined in accordance with Section 2(d)(x) of this Chapter and paragraphs (E)-(H) below. If the Administrator approves an alternative success standard, as allowed by Section 2(d)(x) of this Chapter, the standard shall be based on technical information obtained from a recognized authority (e.g. Soil Conservation Service, Agricultural Research Service, Universities, Wyoming Game and Fish Department, U.S. Fish and Wildlife Service, etc.), or be supported by scientifically valid research. Use of an alternative technical standard shall be supported by concurrence from State and Federal agencies having an interest in management of the affected lands.

(x) The Administrator shall not release the entire bond of any operator until such time as revegetation is completed, if revegetation is the method of reclamation as specified in the operator's approved reclamation plan. Revegetation shall be deemed to be complete when: (1) the vegetation cover of the affected land is shown to be capable of renewing itself under natural conditions prevailing at the site, and the vegetative cover and total ground cover are at least equal to the cover on the area before mining, (2) the productivity is at least equal to the productivity on the area before mining, (3) the species diversity and composition are suitable for the approved postmining land use and the revegetated area is capable of withstanding grazing pressure at least comparable to that which the land could have sustained prior to mining, unless Federal, State or local regulations prohibit grazing on such lands, and (4) the requirements in (1), (2) and (3) are met for the last two consecutive years of the bonding period. The Administrator shall specify quantitative methods and procedures for determining whether equal cover and productivity has been established including, where applicable, procedures for evaluating postmining species diversity and composition. The following options or an alternative success standard approved by the Administrator are available:

(A) The method utilizing control areas may be selected. If selected, the control areas shall be sampled for cover, productivity, species diversity and composition in the same season that the area to be affected is sampled for baseline data. Quantitative premining and postmining vegetation data from the control areas shall be used to mathematically adjust premining affected area data for climatic change. Premining affected area cover and productivity data will be directly compared by statistical procedures to data from the reclaimed vegetation type when evaluating revegetation success for final bond release. Species diversity and composition data will be qualitatively or quantitatively evaluated as determined by the Administrator.

(B) The method utilizing reference areas may be selected. If selected, the

representativeness of the reference area is verified by a statistical comparison to the plant community that it typifies. Postmining cover and productivity data from the reference area are directly compared by standard statistical procedures to data from the reclaimed area when evaluating revegetation success for final bond release. Species diversity and composition data will be qualitatively or quantitatively evaluated as determined by the Administrator.

(C) Where the premining cover, productivity, species diversity and composition data cannot be collected, or where the area to be affected is small and incidental to the operation, comparison areas may be selected. For purposes of this method, postmining qualitative and quantitative data from the comparison area are directly compared by procedures acceptable to the Administrator to data from the reclaimed lands when evaluating success of revegetation for final bond release.

(D) Without regard to the type of method selected, control, reference or comparison areas should be at least two acres in size, located in areas where they will not be affected by future mining, while serving their designated use, managed in a fashion which will not cause significant changes in the vegetation parameters of cover, productivity, species diversity and composition and be representative of the postmining land use.

(E) The postmining density, composition, and distribution of shrubs shall be based upon site-specific evaluation of premining vegetation and wildlife use. Shrub reclamation procedures shall be conducted through the application of best technology currently available.

(I) Except where a lesser density is justified from premining conditions in accordance with Appendix A, at least 20 percent of the eligible lands shall be restored to shrub patches supporting an average density of one shrub per square meter. Patches shall be no less than .05 acres each and shall be arranged in a mosaic that will optimize habitat interspersion and edge effect. Criteria and procedures for establishing the standard are specified in Appendix A. This standard shall apply to all lands affected after August 6, 1996.

(II) Approved shrub species and seeding techniques shall be applied to all remaining grazingland. Trees shall be returned to a density equal to the premining conditions.

(III) For areas containing crucial habitat, designated as such prior to the submittal of a permit application or any subsequent amendment, or critical habitat the Wyoming Game and Fish Department shall be consulted about, and its approval shall be required for, minimum stocking and planting arrangements of shrubs, including species composition. For areas determined to be important habitat, the Wyoming Game and Fish Department shall be consulted for recommended minimum stocking and planting arrangements of shrubs, including species composition, that may exceed the programmatic standard discussed above.

(F) Where trees are part of the approved reclamation plan, at the time of bond release the trees to meet the required stocking rate shall be healthy, and at least 80 percent shall

have been planted for at least eight years.

(G) Standards for the success of reforestation for commercial harvest shall be established in consultation with forest management agencies and prior to approval of any mining and reclamation plan that proposes reforestation. If reforestation for commercial harvest is the method of revegetation, reforestation shall be deemed to be complete when a reasonable population density as established in the reclamation plan has been achieved, the trees have shown themselves capable of continued growth for a minimum period of five years following planting, and the understory vegetation is adequate to control erosion and is appropriate for the land use goal. Quality and quantity, vegetation cover, productivity, and species diversity shall be determined in accordance with scientifically acceptable sampling procedures approved by the Administrator.

(H) If the Administrator approves a long-term, intensive agricultural postmining land use, the ten year period of liability shall commence at the date of initial planting for such long-term agricultural use.

(I) When the approved reclamation plan is to return to cropland, reclamation shall be deemed to be complete when productive capability is equivalent, for at least two consecutive crop years, to the premining conditions or approved reference areas. The premining production data for the reclaimed site shall be considered in judging completeness of reclamation whenever said data are available.

(xi) Monitoring of permanent revegetation on reclaimed areas before and after grazing shall be conducted at intervals throughout the period prior to bond release in accordance with the plan required by Chapter 2, Section 2(b)(vii). Monitoring results shall be presented in the annual report.

(xii) Any plans for irrigation must be explained.

(xiii) The operator must protect young vegetative growth from being destroyed by livestock by fencing or other approved techniques for a period of at least two years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. The Administrator, permittee and the landowner or land managing agency shall determine when the revegetated area is ready for livestock grazing.

(xiv) In those areas where there were no or very few noxious weeds prior to being affected by mining, the operator must control and minimize the introduction of noxious weeds into the revegetated areas for a period of at least five years after the initial seeding.

(e) Diversion systems and drainage control.

(i) Diversion of streams.

(A) All diversions shall be designed to assure public safety, prevent material damage outside the permit area, and minimize adverse impacts to the hydrologic balance.

(B) All diversions and associated structures shall be designed, constructed, maintained and used to ensure stability, prevent, to the extent possible using best technology currently available, additional contribution of suspended solids to streamflow outside the permit area, and comply with all applicable local, State and Federal rules.

(C) Permanent diversions of intermittent and perennial streams shall be designed and constructed so as to be erosionally and geomorphically compatible with the natural drainage system.

(D) The design and construction of all diversions for perennial or intermittent streams shall be certified by a qualified registered professional engineer as meeting the diversion standards of these regulations and the approved permit.

(E) When permanent diversions are constructed or stream channels restored after temporary diversions, the operator shall:

(I) Restore, enhance where practicable, or maintain natural riparian vegetation on the banks and flood plain of the stream;

(II) Establish or restore the stream characteristics, including aquatic habitats to approximate premining stream channel characteristics; and

(III) Establish and restore erosionally stable stream channels and flood plains.

(F) The operator shall renovate all permanent diversions in accordance with the approved reclamation plan prior to abandonment of the permit area.

(G) When no longer needed to achieve the purpose for which they were authorized, all temporary diversions shall be removed and the affected land regraded and revegetated, in accordance with this Chapter. Before diversions are removed, downstream water treatment facilities previously protected by the diversion shall be modified or removed, as necessary, to prevent overtopping or failure of the facilities. This
requirement shall not relieve the operator from maintaining water treatment facilities as otherwise required.

(ii) Control of discharge or drainage.

(A) Discharge from sedimentation ponds, permanent and temporary

impoundments, coal-processing waste dams and embankments, and diversions shall be controlled, by energy dissipators, riprap channels, and other devices, where necessary, to reduce erosion, to prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance. Discharge structures shall be designed according to standard engineering design procedures.

(B) Drainage from acid-forming and toxic-forming material into ground and surface water shall be avoided by:

(I) Identifying, burying, and treating where necessary, material which, in the judgment of the Administrator may adversely affect water quality if not treated or buried;

(II) Preventing water from coming into contact with acid-forming and toxic-forming material and other measures as required by the Administrator; and

(III) Complying with the requirements of subsection (c)(xiii) of this Section and such other measures deemed necessary by the Administrator to protect surface water and groundwater.

(C) Surface water shall not be diverted or otherwise discharged into underground mine workings unless specifically authorized by the Administrator per the requirements of Chapter 19, Section 2(a) of these regulations.

(iii) In addition to meeting the standards of this Section, all diversions of groundwater discharge flows shall meet the standards of Section 2(e).

(iv) Diversion systems - Unchannelized surface water and ephemeral streams.

(A) Surface water shall be diverted around the operation for the following purposes:

(I) To control water pollution.

(II) To control unnecessary erosion.

(III) To protect the on-going operation.

(IV) To protect the water rights of downstream users.

(B) Temporary diversion of surface runoff or diversions used for erosion control shall meet the following standards:

(I) In soils or other unconsolidated material, the sides of diversion ditches shall be no steeper than 1½:1.

(II) In rock, the sides of diversion ditches shall not overhang.

(III) In soils or unconsolidated materials, the sides and, in ditches carrying intermittent discharges, the bottom shall be seeded with approved grasses so as to take advantage of the next growing season.

(IV) Rock riprap, concrete, soil cement or other methods shall be used where necessary to prevent unnecessary erosion.

(V) Culverts or bridges shall be installed where necessary to allow access by the surface owner for fire control and other purposes.

(VI) Diversion ditches shall in a nonerosive manner pass the peak runoff from a 2-year, 6-hour precipitation event, or a storm duration that produces the largest peak flow, as specified by the Administrator.

(C) In no case shall diversion ditches discharge upon topsoil storage areas, spoil or other unconsolidated material such as newly reclaimed areas.

(D) Permanent diversion structures shall be designed to be erosionally stable during the passage of the peak runoff from a 100-year, 6-hour precipitation event, or a storm duration that produces the largest peak flow, as specified by the Administrator.

(v) Diversion of intermittent and perennial streams.

(A) In no case shall spoil, topsoil, or other unconsolidated material be pushed into, or placed below the flood level of a perennial or intermittent stream except during the approved construction of the diversion of said stream.

(B) The Wyoming Game and Fish Department shall be consulted prior to the approval of a diversion of a perennial or intermittent stream.

(C) The banks of a diverted perennial or intermittent stream shall be protected by vegetation by planting approved species to take advantage of the next growing season.

(D) The banks and channel of a diverted perennial or intermittent stream shall be protected where necessary by rock, riprap or similar measures to minimize erosion and degradation of water quality. Permanent diversions shall be designed and constructed to be erosionally stable. The design of the permanent diversion shall also be consistent with the role of the fluvial system.

(E) Mining on the flood plain of a perennial or intermittent stream shall not be permitted if it would cause the uncontrolled diversion of the stream during periods of high water.

(F) Waters flowing through or by the mining operation shall meet the standards set by the U.S. Environmental Protection Agency and the Wyoming Water Quality Division in regard to the effect of the operation upon such waters.

(G) If temporary, the channel and flood plain shall be designed to pass, in a nonerosive manner, the 10-year, 6-hour precipitation event, or the capacity of the unmodified stream channel immediately above and below the diversion, whichever capacity is greater, or a duration having a greater peak flow, as specified by the Administrator. Cross-sections of the existing stream above, below and within the disturbed area may be used to determine the flow capacities, channel configuration and shape.

(H) If permanent, the channel and flood plain shall be designed to pass, in a nonerosive manner, the 100-year, 6-hour precipitation event, or a duration having a greater peak flow, as specified by the Administrator. Cross-sections of the existing stream above, below and within the disturbed area may be used to determine the flow capacities, channel configuration and shape.

(f) Sedimentation ponds.

(i) All surface drainage from affected lands excluding sedimentation ponds, diversion ditches, and road disturbances, shall pass through a sedimentation pond(s) before leaving the permit area. Sedimentation control devices shall be constructed prior to disturbance. The Administrator may grant exemptions to the use of sedimentation ponds where, by the use of alternative sediment control measures, the drainage will meet effluent limitation standards or will not degrade receiving waters.

(ii) Where the sedimentation pond(s) results in the mixing of drainage from affected lands with the drainage from undisturbed areas, the permittee shall comply with the applicable effluent limitation standards for all of the mixed drainage where it leaves the permit area.

(iii) Sedimentation ponds shall be designed and constructed to comply with the applicable requirements of subsection (g)(iv-vii) of this Chapter. They shall be located as near as possible to the affected lands and out of intermittent or perennial streams; unless approved by the Administrator.

(iv) Sedimentation ponds shall be operated and maintained to comply with the requirements of the Water Quality Division and the State Engineer's Office and satisfy the following requirements:

(A) Chemicals that will harm fish, wildlife, and related environmental values shall not be used for flocculation or other water treatments or if used these ponds will be protected.

(B) Sedimentation ponds shall be designed and maintained to contain adequate sediment storage as determined by acceptable empirical methods.

(C) Sluicing of collected sediments shall be prevented for the design precipitation event.

(D) All areas disturbed by the construction of the sedimentation pond shall be revegetated as soon as practicable to reduce erosion.

(v) The design, construction, and maintenance of a sedimentation pond or other sediment control measures in accordance with this subsection shall not relieve the operator from compliance with applicable effluent limitation standards of the Water Quality Division.

(vi) Sediment ponds shall be maintained until removal is authorized by the Division and the affected lands have been stabilized and initial vegetation established
in accordance with the approved reclamation plan and the requirements of this Chapter. In no case shall sediment ponds treating reclaimed lands be removed sooner than two years after the last augmented seeding.

(vii) Sediment control measures for affected lands. Appropriate sediment control measures shall be designed, constructed, and maintained using the best technology currently available to prevent additional contributions of sediment to streamflow or to runoff outside the affected land. Such measures may consist of limiting the extent of disturbed land and stabilizing, diverting, treating or otherwise controlling runoff.

(g) Permanent and temporary water impoundments.

(i) Permanent water impoundments are prohibited unless authorized by the Administrator on the basis that:

(A) The impoundment and its water quality and quantity will support or constitute a postmining use equal to or greater than the highest previous use of the land.

(B) Discharge of water, if any, from the impoundment shall not degrade the quality of receiving waters.

(C) The surface landowner, if different from the mineral owner, has consented to the impoundment.

(ii) Permanent water impoundments. Permanent water impoundments shall be constructed in accordance with the following requirements:

(A) Dams must contain an overflow notch and spillway so as to prevent

failure by overfilling and washing. Overflow notches and spillways must be riprapped with rock or concrete to prevent erosion.

(B) The slopes around all water impoundments must be gentle enough so as not to present a safety hazard to humans or livestock and so as to accommodate revegetation. Variations from this procedure may be approved by the Administrator based on the conditions present at the individual locality.

(C) Mineral seams and other sources of possible water contamination within the impoundment area must be covered with overburden or stabilized in such a manner to prevent contamination of the impounded water.

(D) Bentonite or other mire-producing material within the impoundment basin shall be removed or covered with materials which will prevent hazards to man or beast.

(iii) The phrase "major impoundment" shall mean any structure impounding water, sediment or slurry:

(A) To an elevation of 20 feet or more above the upstream toe to the crest of the emergency spillway; or

(B) To an elevation of five feet above the upstream toe of the structure and has a storage volume of 20 acre-feet or more; or

(C) Which will be retained as part of the postmining land use, and:

(I) Has an embankment height greater than 20 feet as measured from the downstream toe of the embankment to the top of the embankment; or

(II) Has an impounding capacity of 20 acre-feet or greater.

(iv) The design, construction and maintenance of permanent and temporary impoundments shall be approved by the State Engineer's Office. In addition, the following design and construction requirements shall be applicable:

(A) The design of impoundments shall be certified by a qualified registered professional engineer as designed to meet the requirements of this part and the applicable requirements of the State Engineer, using current, prudent engineering practices. For major impoundments, the certification also shall be filed with the State Engineer.

(B) The vertical portion of any remaining highwall shall be located far enough below the low water line along the full extent of highwall to provide adequate safety and access for the proposed water users.

(C) Faces of embankments and surrounding areas shall be vegetated, except that faces where water is impounded may be riprapped or otherwise stabilized in accordance with accepted design practices, or where appropriate, Water Quality Division rules and regulations.

(D) The embankment, foundation, and abutments for all impoundments shall be designed and constructed to be stable. For any major impoundment or any impoundment which may present a danger to life, property or the environment, the Administrator shall require sufficient foundation investigations and laboratory testing to demonstrate foundation stability, and shall require a minimum static safety factor of 1.5 for the normal pool with steady seepage saturation conditions, and a seismic safety factor of at least 1.2.

(E) All vegetative and organic materials shall be removed and foundations excavated and prepared to resist failure. Cutoff trenches shall be installed if necessary to ensure stability.

(F) All impoundments shall be inspected regularly during construction and immediately after construction by a qualified registered professional engineer or qualified professional specialist under the direction of a qualified professional engineer. These individuals shall be experienced in impoundment construction. Immediately following each inspection a report shall be prepared and certified by the engineer describing the construction work observed and its conformance with the approved designs. All inspection reports shall be retained at the mine site and submitted in the annual report to the Administrator.

(G) After completion of construction and until final bond release or removal, all impoundments shall be inspected annually by a qualified registered professional engineer, or by a qualified professional specialist under the direction of the qualified professional engineer. These individuals shall be experienced in impoundment construction. Immediately following each inspection a report shall be prepared and certified by the engineer describing:

(I) Existing and required monitoring procedures and instrumentation;

(II) Depth and elevation of any impounded water;

(III) Existing storage capacity;

(IV) Aspects of the dam that may affect its stability or present any other hazardous condition; and

(V) If the impoundment is being maintained in accordance with the approved design and this Chapter. All annual inspection reports shall be retained at the mine site and annually submitted to the Administrator.

(H) In addition to the post-construction annual inspection requirements

contained in paragraph (G) immediately above, all impoundments must be inspected during each of the intervening calendar quarters by a qualified individual designated by the operator. These inspections shall look for appearances of structural weakness and other hazardous conditions.

(I) Those impoundments subject to 30 CFR § 77.216 shall also be inspected in accordance with 30 CFR § 77.216-3.

(J) If any examination of inspection discloses that a potential hazard exists, the operator shall promptly inform the Administrator of the finding and of the emergency procedures formulated for public protection and remedial action. If adequate procedures cannot be formulated or implemented the Administrator shall be notified immediately. The Administrator shall then notify the appropriate agencies that other emergency procedures are required to protect the public.

(K) Impoundments meeting the criteria of 30 CFR § 77.216(a) shall comply with the requirements of 30 CFR § 77.216. The plan required to be submitted to the District Manager of MSHA under 30 CFR § 77.216 shall also be submitted to the Administrator as part of the permit application.

(v) The design precipitation event for the spillways for temporary water impoundments shall be a 25-year, 6-hour precipitation event, or a storm duration having a greater peak flow, as may be required by the Administrator.

(vi) The design precipitation event for the spillways for a permanent impoundment shall be a 100-year, 6-hour precipitation event, or a storm duration having a larger peak flow, as may be required by the Administrator.

(vii) Before abandoning an area or seeking bond release, the operator shall ensure that all temporary structures are removed and reclaimed, and that all permanent structures are renovated, if necessary to meet the requirements of this subsection and to conform to the approved reclamation plan.

(viii) Tailings impoundments.

(A) Impoundments to contain mill tailings or slurry tailings shall be constructed in accordance with established engineering principles and shall be approved by the Wyoming State Engineer's Office. A copy of the State Engineer's approval shall be attached to the application.

(B) Reclamation of tailings impoundments shall be accomplished by removal and storage of all topsoil present within the tailings basin. After termination of operations, the topsoil shall be replaced and revegetated in accordance with these rules and regulations. If other methods of reclamation and stabilization against wind and water erosion are found to be necessary because of natural conditions, this must be stated and described subject to the Administrator's

approval.

(h) Protection of Groundwater Recharge Capacity - The recharge capacity of the reclaimed lands shall be restored to a condition which:

(i) Supports the approved postmining land use;

(ii) Minimizes disturbances to the prevailing hydrologic balance in the permit area and in adjacent areas; and

(iii) Provides a rate of recharge that approximates the premining recharge rate.

(i) Surface water and groundwater quality and quantity shall be monitored until final bond release to determine the extent of the disturbance to the hydrologic balance. Monitoring shall be adequate to plan for modification of surface mining activities, if necessary, to minimize adverse affects on the water of the State. The operator is responsible for properly installing, operating, maintaining and removing all necessary monitoring equipment. In addition, the operator is responsible for conducting monitoring in accordance with the approved monitoring plan, and submitting all routine monitoring results to the Administrator at least annually. Routine monitoring results shall also be maintained on-site and available to the Director's designated authorized representative, and shall be reasonably current. Noncompliance results for NPDES discharges shall be promptly reported by the operator to the Water Quality Division Administrator. The operator shall promptly report all other noncompliance results to the Land Quality Division Administrator and shall, after consultation with the Administrator, implement appropriate and prompt mitigative measures for those noncompliance situations determined to be mining caused. The monitoring system shall be based on the results of the probable hydrologic consequences assessment and shall include:

(i) A groundwater monitoring program to determine:

(A) Infiltration rates, subsurface flows, and storage characteristics of the reclaimed land and adjacent areas;

(B) The effects of reclamation on the recharge capacity of the reclaimed lands; and

(C) Suitability of groundwater for current and approved postmining land uses.

(ii) A surface water monitoring program which includes monitoring of surface water flow and quality from affected lands including those that have been graded and stabilized. Results of the monitoring will be used to demonstrate that the quality and quantity of runoff from affected lands with or without treatment will minimize disturbance to the hydrologic balance. Water quality monitoring results for discharges other than those authorized by Water Quality Division shall

be reported whenever results indicate noncompliance with effluent limitation standards or degradation of the quality of receiving water shall be reported immediately. Monitoring results shall be available for inspection at the mine site.

(j) Roads and other transportation facilities.

(i) General standards for all transportation facilities.

(A) Roads and railroads. Constructed or upgraded roads and railroad spurs shall be included within the permit area from that point that they provide exclusive service and shall be covered by a reclamation bond.

(B) Roads shall not be constructed up a stream channel or so close that the material shall spill into the channel, unless specifically approved by the Administrator.

(C) Streams shall be crossed at or near right angles unless contouring down to the streambed will result in less potential stream bank erosion. Structure of ford entrances and exits must be constructed to prevent water from flowing down the roadway.

(D) Drainage control structures shall be used as necessary to control runoff and to minimize erosion, sedimentation and flooding. Drainage facilities shall be installed as road construction progresses.

(E) Culverts shall be installed at prominent drainageways, or as required by the Administrator. Where necessary, culverts must be protected from erosion by adequate rock, concrete or riprap. Culverts and drainage pipes shall be constructed to avoid plugging, collapsing, or erosion at inlets and outlets.

(F) Trees and vegetation may be cleared only for the essential width necessary to maintain slope stability and to serve traffic needs.

(G) Access, haul roads and drainage structures shall be routinely maintained.

(H) Exemptions concerning roads.

(I) If approval is obtained from the surface landowner to leave a road unreclaimed, an operator may request in writing to the Land Quality Division that a road be permitted to remain unreclaimed. The operator must furnish proof of the surface landowner's approval. Final decision of road reclamation will be made by the Land Quality Division Administrator.

(II) In the event that the surface landowner, a city or town, another agency of the State of Wyoming or an agency of the United States government has requested that a

road not be reclaimed, no bond shall be required of the applicant for the reclamation of the road and reclamation of the road shall not be required; provided, however, that the Administrator receives a copy of the written request from the surface owner, city or town, or agency of the State or Federal Government, for retention of the road.

(ii) General performance standards for haul roads, access roads or light-use roads:

(A) Roads shall be located on ridges or on the most stable available slopes to minimize erosion, sedimentation and flooding. All exposed surfaces shall be stabilized in accordance with current, prudent engineering practices.

(B) Acid or toxic-forming substances shall not be used in road surfacing.

(C) To the extent possible using the best technology currently available, roads shall not cause damage to fish, wildlife, and related environmental values and shall not cause additional contributions of suspended solids to streamflow or to runoff outside the affected land or permit area. Any such contribution shall not be in excess of limitations of State or Federal law or degrade the quality of receiving water.

(D) The normal flow of water in streambeds and drainage channels shall not be significantly altered. Damage to public or private property shall be prevented or controlled.

(E) All embankments shall have, at a minimum, a static safety factor of 1.3.

(F) The design and construction or reconstruction shall incorporate appropriate limits for grade, width, surface materials, surface drainage control, culvert placement, culvert size, and such other design criteria required by the Administrator to ensure environmental protection and safety appropriate for the planned duration and use.

(G) All roads shall be maintained and/or repaired, if damaged, to meet the performance standards of this subsection.

(H) All roads shall be closed to vehicular travel when no longer needed and reclaimed in accordance with this Chapter, unless the road is retained for use under an approved postmining land use.

(iii) Performance standards for haul roads and access roads.

(A) Design and construction: The design and construction or reconstruction of haul roads and access roads shall be certified by a registered professional engineer as meeting the requirements of this subsection; current, prudent engineering practices; and any design criteria required by the Administrator.

(B) Stream fords are prohibited unless they are specifically approved by the Administrator as temporary routes during periods of construction.

(C) Drainage.

(I) Haul and access roads shall be designed, constructed, or reconstructed and maintained with drainage control structures capable of safely passing the runoff from a 10-year, 6-hour precipitation event, or a storm duration having a greater peak flow, unless otherwise specifically approved by the Administrator. The drainage control system shall include, but not be limited to bridges, culverts, ditches, cross drains, and ditch-relief drains.

(II) All drainage pipes or culverts shall be constructed and maintained to avoid plugging, collapse and erosion at inlets and outlets.

(III) All culverts shall be designed, constructed, and maintained to sustain the vertical soil pressure, passive resistance of the foundation, and the weight of vehicles to be used.

(IV) Ephemeral (shown on a USGS 7.5 minute series quad), intermittent or perennial streams shall not be altered or relocated for road construction or reconstruction without approval from the Administrator, and then, only if the natural channel drainage is not blocked except during periods of low flow or when flow has been acceptably diverted around the site, there is no significant damage to hydrologic balance, and there is no adverse impact on adjoining landowners.

(V) Drainage ditches shall be designed to prevent uncontrolled drainage over the road surface and embankment. Trash racks and debris basins shall be installed in the drainage ditches where debris from the drainage area may impair the functions of drainage and sediment control structures.

(VI) Except as provided in (B) above, drainage structures which are used for stream channel crossings shall be made using bridges, culverts, or other structures designed, constructed, and maintained using current, prudent engineering practices.

(D) Surfacing: Roads shall be surfaced with rock, crushed gravel, asphalt, or other material sufficiently durable for the anticipated volume of traffic and weight and speed of vehicles to be used.

(E) Maintenance: Routine maintenance shall include repairs to the road surface, blading, filling potholes and adding replacement gravel or asphalt. It shall also include revegetation, brush removal, and minor reconstruction of road segments as necessary.

(iv) Railroad and other transportation and mine facilities.

(A) Railroad loops, spurs, sidings, surface conveyor systems, chutes, aerial tramways, or other transportation and mine facilities shall be designed, constructed, or reconstructed, and maintained and the area restored to:

(I) Prevent, to the extent possible using the best technology currently available, damage to fish, wildlife, and related environmental values, and additional contributions of suspended solids to streamflow or runoff outside the affected land and permit area. Any such contributions shall not be in excess of limitations of State or Federal law or degrade the quality of receiving water.

(II) Control and minimize diminution or degradation of water quality and quantity.

(III) Control and minimize erosion and siltation.

(IV) Control and minimize air pollution.

(V) Prevent damage to public or private property.

(B) Railroads and other transportation and mine facility areas shall be reclaimed when no longer needed for the operation in accordance with the requirements of this Chapter.

(k) Time schedule.

(i) Reclamation must begin as soon as possible after mining commences and must continue concurrently until such time that the mining operation is terminated and all of the affected land is reclaimed. If conditions are such that final reclamation procedures cannot begin until the mining operation is completed, this must be explained in the reclamation plan. A detailed time schedule for the mining and reclamation progression must be included in the reclamation plan. This time schedule shall:

(A) Apply to reclamation of all lands to be affected in the permit area;

(B) Designate times for backfilling, grading, contouring and reseeding;

(C) Be coordinated with a map indicating the areas of progressive mining and reclamation;

(D) Establish reclamation concurrently with mining operations, whenever possible. If not possible, the schedule shall provide for the earliest possible reclamation consistent with the orderly and economic development of the property; and

(E) If the Administrator approves a schedule where reclamation follows

the completion of mining, describe the conditions which will constitute completion or termination of mineral production.

(l) Unanticipated conditions.

(i) An operator encountering unanticipated conditions shall notify the Administrator as soon as possible and in no event more than five days after making the discovery.

(ii) An unanticipated condition is any condition encountered in a mining operation and not mentioned by the operator in his mining or reclamation plan which may seriously affect the procedures, timing, or outcome of mining or reclamation. Such unanticipated conditions include but are not limited to the following:

(A) The uncovering during mining operations of any acid-forming, radioactive, inflammable, or toxic materials which must be burned, impounded, or otherwise disposed of in order to eliminate pollution or safety hazards.

(B) The discovery during mining operations of a significant flow of groundwater in any stratigraphic horizon.

(C) The occurrence of slides, faults, or unstable soil and overburden materials which may cause sliding or caving in a pit which could cause problems or delays with mining or reclamation.

(D) The occurrence of uncontrolled underground caving or subsidence which reaches the surface, causing problems with reclamation and safety hazards.

(E) A discovery of significant archaeological or paleontological importance.

(iii) In the case of the uncovering of hazardous materials, the operator shall take immediate steps to notify the Administrator and comply with any required measures to eliminate the pollution or safety hazard. Under all conditions the operator must take appropriate measures to correct, eliminate, or adapt to an unanticipated condition before mining resumes in the immediate vicinity of that condition.

(m) Disposal of buildings and structures.

(i) All buildings and structures constructed, used or improved by the operator must be removed or dismantled unless it can be demonstrated to the Administrator's satisfaction that the buildings or structures will be of beneficial use in accomplishing the proposed use of the land after reclamation or for environmental monitoring.

(ii) If the operator does not wish to remove certain buildings or facilities, he must

obtain the written consent of the surface landowner to leave the buildings or facilities intact. The operator must make a request in writing, providing written proof of the above to the Land Quality Division, that the buildings or facilities be permitted to remain intact.

(n) All support buildings, including loading and storage facilities, plants, sheds, shops and other buildings shall be designed, constructed or reconstructed and located to prevent or control erosion, pollution, and damage to public or private property, fish, wildlife, and related environmental values. All operations shall be conducted so as to minimize disruption of any services provided by facilities located on, under or through the permit area, unless otherwise approved by the Administrator or owner of such facilities.

(o) Signs and markers. Uniform and durable signs and markers of an adequate size shall be posted by the operator at those points applicable to the areas or activities to which they pertain. Such signs and markers shall include mine and permit identification signs, perimeter markers, buffer zone markers, blasting signs and soil markers. The operator shall place and maintain all signs and markers prior to commencement and until the completion of the activities to which they pertain, which, for mine and permit identification signs, shall be at the time the bond is released.

(p) Drilled holes and other exposed underground openings: Plugging, sealing and capping of all drilled holes except those used solely for blasting or developmental drill holes which will be mined through within one year shall meet the requirements of Chapter 14. Developmental drilling shall meet the plugging and sealing requirements of W.S. § 35-11-404, where necessary. Temporary sealing and use of protective devices may be approved by the Administrator if the hole will be used for returning coal-processing waste or water to underground workings or monitoring groundwater conditions, and shall be used, at a minimum, for developmental drilling. Other exposed underground openings shall be properly managed as required by the Administrator to prevent access to mine workings and to keep acid or other toxic drainage from entering ground or surface water.

(i) With the prior approval of the Administrator and the State Engineer, wells may be transferred to another party for further use. The permittee shall remain responsible for the proper management of the well until final bond release.

(q) Air resources protection. All exposed surface areas shall be protected and stabilized to effectively control erosion and air pollution attendant to erosion.

(r) Fish and wildlife performance standards.

(i) An operator shall, to the extent possible using the best technology currently available and consistent with the approved postmining land use, minimize disturbance and adverse impacts on fish, wildlife, and related environmental values, and achieve enhancement of such resources where practicable, which activities shall include:

(A) Properly construct, locate and operate roads and power lines, including proper design of power lines to avoid electrocution of raptors.

(B) Prevent access to areas such as roadways or ponds with hazardous materials, to avoid damage to wildlife without limiting access to known important routes.

(C) Afford protection, restore and enhance where practicable important habitats to fish and wildlife. This shall include, but is not limited to, wetlands and riparian vegetation along rivers and streams and bordering ponds and lakes.

(D) Select plant species with shrubs well represented, which will enhance the nutritional and cover aspects of fish and wildlife habitat, where such habitat is identified as part of the postmining use, and distribute the reestablished habitat in a manner which includes a diversity and interspersion of habitats, optimizes edge effect, cover and other benefits for fish and wildlife, and is consistent with Section 2(d)(x)(E).

(E) Promptly report to the regulatory authority any species or critical habitat of such species listed as threatened or endangered, or any golden or bald eagle nest in or adjacent to the permit area, which was not reported or investigated in the permit application. Upon notification the Administrator shall consult with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service and, after consultation, shall identify whether and under what conditions the operator may proceed.

(F) Where the postmining land use is for cropland, to the extent not inconsistent with this intended use, operators shall restore habitat types to break up large blocks of monocultures.

(ii) Stream buffer zone.

(A) No land within 100 feet of a perennial or intermittent stream shall be affected unless the Administrator specifically authorizes such activities closer to or through such a stream upon a finding that:

(I) Surface mining activities will not cause or contribute to the violation of applicable state or federal water quality standards, and will not adversely affect the water quantity and quality or other environmental resources of the stream; and

(II) If there will be a temporary or permanent stream-channel diversion, it will comply with all stream diversion requirements.

(B) The area not to be affected shall be designated a buffer zone, marked in the field and on the mine plan map.

(iii) No surface mining activity shall be conducted which is likely to jeopardize the continued existence of endangered or threatened species listed by the State or the Secretary of the Interior or which will result in the destruction or adverse modification of designated critical habitats of such species in violation of the Endangered Species Act (16 U.S.C. 1531 et seq.). No

surface mining activity shall be conducted in a manner which would result in the unlawful taking of a bald or golden eagle, its nest, or any of its eggs. The Administrator shall consult with the State and Federal Fish and Wildlife Agencies to identify whether and under what conditions the operation may continue under this provision.

(iv) The operator shall perform periodic surveys, in the level of detail and for those areas as determined by the Administrator, in accordance with Appendix B of these rules and regulations.

(s) Slides and other damage. Where instability may exist in backfill materials, an undisturbed natural barrier shall be provided to prevent slides and erosion, beginning at the elevation of the lowest coal seam to be mined and extending from the outslope for such distance as may be determined by the Administrator.

(t) Only those operations designed to protect disturbed surface areas and which result in improved resource recovery, abatement of water pollution, or elimination of hazards to the public shall be conducted within 500 feet of an active or abandoned underground mine. Approval for such operation shall be obtained from MSHA for operations proposed to be conducted within 500 feet of an active underground mine. The Administrator shall specifically approve operations proposed to be conducted within 500 feet of an abandoned underground mine.

(u) Cessation of operations. When it is known that a temporary cessation of operations will extend beyond 30 days, the operator shall submit to the Administrator that information required in an annual report.

(v) The operator shall conduct operations so as to maximize the utilization and conservation of the solid fuel resource being recovered so that reaffecting the land in the future can be minimized.

(w) The operator shall conduct all operations in such a manner as to minimize disturbance of the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area, to assure the protection or replacement of water rights, and to support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of this Chapter. Mining and reclamation practices that minimize water pollution and changes in flow shall be used in preference to water treatment.

Appendix B: Wyoming Guideline No. 15

(HP/2-90, Riles Update/8-94)

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION
GUIDELINE NO. 15

ALTERNATIVE SEDIMENT CONTROL MEASURES

This document is a guideline only. Its contents are not to be interpreted by applicants, operators, or LQD staff as mandatory. If an operator wishes to pursue other alternatives, he or she is encouraged to discuss these alternatives with the LQD staff.

I. INTRODUCTION

This guideline identifies specific sediment control measures that may be used in addition to or in place of sedimentation ponds. Operators should note that alternative sediment control design requirements are minimal for areas less than 30 acres. Monitoring requirements are also minimal for small ephemeral receiving streams (drainage areas less than 0.5 square miles). Land Quality Division (LQD) will rely on field inspections of small areas, focusing on construction and maintenance to ensure their effectiveness.

These recommendations do not constitute the only acceptable alternative sediment control techniques. LQD intends to maintain flexibility so that they can evaluate sediment control systems not envisioned in this guideline. The final sediment control system should conform to the standards described herein for design, construction, maintenance, and monitoring.

Even where sedimentation ponds are constructed, alternative sediment control changes can be used to minimize sediment delivery to ponds and thereby decrease the frequency of pond maintenance. Alternative techniques are especially applicable to large reclaimed watersheds, where erosion must be controlled before a downstream pond is eliminated.

II. Objective of Alternative Sediment Control Measures (ASCM's)

Alternative sediment control measures are presented as an option other than the use of sedimentation ponds in the WDEQ/LQD Coal Rules and Regulations when it can be demonstrated that they "will not degrade receiving waters" (Chapter IV, Section 2.(f)(I)). Receiving waters are defined by the LQD as:

1. Any unimpounded and undisturbed or permanently reclaimed stream outside of the permit area that is within three (3) channel miles downstream of an area controlled by an ASCM; or

2. Any unimpounded and undisturbed or permanently reclaimed stream within the permit area downstream of an ASCM.

As stated in Chapter IV, Section 2.(f)(vii), "Appropriate sediment control measures shall be designed, constructed, and maintained using the best technology currently available to prevent additional contributions of sediment to streamflow or to runoff outside the affected land". Also, a surface water

monitoring program "...will be used to demonstrate that the quality and quantity of runoff from affected lands...will minimize disturbance to the hydrologic balance". (Chapter IV, Section 2.(I)(ii)).

These regulations suggest that there is a design/maintenance standard, **best technology currently available (BTCA),** a performance standard, **non-degradation of receiving waters,** and a verification standard, **demonstrable monitoring program.** ASCM's should be designed such that it can be demonstrated that sediment yields are not greater than background levels.

III. Best Technology Currently Available (BTCA)

A. Elements of BTCA.

The design methods, construction techniques, maintenance practices and monitoring system all contribute to a system that can be considered BTCA.

B. Determination of BTCA.

1. BTCA will be determined on a case by case basis. BTCA determinations will be based on the type of disturbance, the size of the disturbance and the length of time the ASCM will be in place. The LQD will not require the same ASCM sophistication on, for example, small temporary topsoil stockpiles or topsoil stripping areas as they will for a permanently reclaimed watershed. The determination of BTCA will be based on how effective the ASCM is at:

    a. Preventing soil detachment and erosion, using slope erosion control practices.

    b. Retaining sediment as close as possible to its point of origin, using on-slope and in-channel sediment trapping structures.

    It is preferable to use effective slope erosion control practices where possible. Sediment traps should constitute a second line of defense.

2. The LQD realizes that many technologies currently exist that can be considered the "best" technology. New technologies may be developed in the near future that may provide a higher degree of erosion protection than is "currently" available.

IV. Design of ASCM's

ASCM's can be considered for disturbed or reclaimed areas that are not within one-half mile (channel distance) of any class I, II, or III stream. (These classes are defined in the WDEQ/WQD Rules and Regulations, Chapter I, Section 4). Small areas (less than 30 acres) located within one half mile of a class I, II, or III stream, may be protected using ASCM's, subject to the discretion of the LQD administrator.

A. Designing ASCM's for Small Areas (less than 30 acres)

The only sediment control design requirements for small disturbed area (less than 30 acres) are:

1. Sediment trapping structures (e.g., toe ditches, rock check dams) should be designed to pass or detain runoff from storms of recurrence intervals determined by their expected lifetimes (see Appendix 1). A generic design may be acceptable where many similar small areas will be controlled by similar structures as long as they will withstand the design precipitation event.

2. Rocks used to construct check dams should be angular and have an appropriate size distribution so that the design peak flow cannot entrain them or else be enclosed in a staked wire mesh structure.

3. Toe ditches should be graded to a zero slope, where practical. Otherwise, toe ditches should be gently graded to a stabilized outlet that has a check dam of porous rock, staked hay bales, or a fabric sediment fence to retain sediment.

4. Detention basins will be considered alternative sediment control only when their capacity is less than 0.5 acre-foot.

5. The operator need only report the ASCM design and its justification with a planview location and a general description of the type structure to the LQD. Proposals of this size should outline the inspection and maintenance programs the operator will use to regularly evaluate the stability and effectiveness of each ASCM.

B. Designing ASCM's for Large Areas (30 acres and larger)

1. The design of ASCM's for large areas should be based on predicted sediment loads or yields from the particular area of disturbance. The operator should compare predicted or measured native sediment yields to those predicted for the disturbed area.

2. A state-of-the-art computer watershed model should be used as an ASCM design tool. The LQD will work with the operator to determine which model(s) can be considered state-of-the-art for the particular application. Section VII of this guideline includes specific model information that should be submitted.

C. Implementation Priorities for Various ASCM's

The following lists prioritize the most desirable ASCM's for each particular disturbed area:

1. Topsoil Stripping Areas

   a. Divert undisturbed water around the stripped area into an approved diversion channel.
   b. Divert drainage from the stripped area into the pit.
   c. Divert drainage from the stripped area away from the pit through an

ASCM:

1. Place native vegetation buffer strips or filter cloth between the disturbance and the channel.
2. Place sediment trapping structures in channel (porous rock check dams, staked straw bales).
3. Place sediment trapping structures below the channel grade.

2. Overburden/Topsoil Stockpiles

a. Utilize a flat construction profile.
b. Locate stockpiles away from drainageways.
c. Use contour plowing, seeding and mulch on stockpiles.
d. Establish a good vegetative cover.
e. Grade contour ditch outlets to stabilized drainageways.
f. Grade toe ditches to sediment trapping structure that retains minimum amount of water.
g. Grade toe ditches to zero grade and less than 0.5 acre-foot capacity.

3. Postmining Surfaces

a. Stable landform design

Geomorphic approaches to stable landform design are highly recommended to minimize sediment yield. For example, drainage density and channel and hillslope profile shapes can be varied and lose lengths reduced to minimize sediment yield.

b. Short-term slope erosion controls

1. Regraded topsoil surfaces should be pitted with a large disc, chisel plow or ripper working along the contour to increase infiltration and detain runoff.

2. Bare rounded surfaces should be mulched and vegetated rapidly. It is highly recommended that mulch be anchored in the topsoil and that vegetation be planted immediately after surface grading. Cover crops provide a standing mulch that can be mowed prior to subsequent plantings.

c. In-channel sediment retention measures

Vegetation is often sufficient to stabilize stream channels. A rock check dam should be placed in channel reaches that produce excessive sediment from their bed and banks. Accumulated sediment should be regularly removed from rock check dams. Check dams should be used as a final resort in permanently reclaimed stream channels.

D. Location of Sedimentation Ponds

Sedimentation ponds must be used to control runoff from facilities areas, coal stockpiles and pit drainage. Sediment ponds may also be necessary when maintenance of ASCM's is a chronic unresolved problem.

V. Construction and Maintenance of ASCM's

A. Construction of ASCM's

Each type of ASCM has construction and maintenance guidelines that are specified in most handbooks on sediment control (see list of references, Appendix 2). Some basic guidelines include:

1. Mulch must be anchored to prevent it from being washed or blown off the slope.

2. Rocks used in porous rock check dams should be the appropriate size, angularity, and density to prevent flows from transporting them or else they should be contained in anchored wire mesh.

3. Contour ditches should be constructed with a stabilized outlet and berms that are well compacted and vegetated.

4. Concentrating flow in a diversion ditch can result in severe erosion by gullying if the outlet is not adequately constructed and stabilized.

5. Baled hay check dams should be staked into the bed and banks of channels. Flow should pass over the low point of the channel. If hay bales are placed level across the channel, they should be staggered so that water will not pond behind them and be deflected into the banks.

B. Maintenance of ASCM's

The operator should report, repair and log any significant damage to an ASCM as soon as possible after the damage occurs. The operator should inspect the ASCM at the beginning and at the end of each runoff season, and after each runoff event. An inspection and maintenance log should be kept to document the condition of each ASCM at the time of each inspection. The log should describe any damage, the required maintenance, and the date repairs were made.

VI. Performance of ASCM's

A. Monitoring Ephemeral Tributary (Class IV) Streams

Where the receiving water is an ephemeral (Class IV) stream, the water quality standard set by WDEQ/WQD Rules and Regulations, Chapter 1, Section 15, is as follows:

"...substances...influenced by the activities of man that will settle to form sludge, bank or bottom deposits shall not be present in quantities which could result in significant aesthetic degradation, ... or adversely affect public water supplies, agricultural or industrial water use, plant life or wildlife, etc."

1. Small ephemeral receiving streams

   Small ephemeral receiving streams (drainage areas less than 0.5 square miles) that are receiving waters for ASCM's should be visually inspected after each runoff event.

   a. Channels and hillslopes should be inspected for signs of rill and gully erosion. The volume and location of any recently accumulated sediments should be recorded.

   b. Repeat photographs should be taken at least annually and after large runoff events at several permanent locations along the receiving stream to supplement the written record of observations.

2. Large ephemeral receiving streams

   In addition to the requirements for visually monitoring small ephemeral receiving streams, monitoring of large ephemeral receiving streams (drainage areas greater than 0.5 square mile) should include one, or both, of the following:

   a. Repeat surveys of representative permanently benchmarked stream channel cross sections located within the disturbed reach of the channel and continuing into the receiving stream channel.

   b. Upstream and downstream sediment yield monitoring stations that follow the plan set forth for Class I, II, and III streams below.

B. Monitoring Class I, II, and III streams

Any class I, II or III receiving stream should be monitored upstream and downstream of the disturbed area so that any potential increase in sediment load related to mining disturbance can be detected.

1. The methods of data collection and the analytical basis for determining whether or not degradation has occurred should be outlined in detail in the ASCM proposal.

2. Continuous flow recorders and automatic sediment samplers should be installed at permanent upstream and downstream station locations.

3. Automatic sediment samplers should begin sampling at the onset of each runoff event and continue at 5 to 10 minute intervals throughout each runoff event. Other sampling intervals or methods will be considered according to their ability to verify sediment yields.

4. The applicant should submit a monitoring station maintenance plan. Data from monitoring stations should be retrieved within 24 hours of each runoff event. Faulty equipment should be immediately repaired or replaced. Monitoring stations should be inspected by the operator after every runoff event, and a log of monitoring and maintenance activities should be kept for LQD review. The LQD will be looking for a long-term record of maintenance as well as a company's efforts to correct problems in a timely fashion.

VII. Contents of an ASCM Proposal

The proposal for implementation of an ASCM for areas greater than 30 acres should include the following items:

A. A general description of the area to be controlled by ASCM's and the types and duration of expected disturbance include the distance to and type of nearest receiving stream and/or Class I, II, or III stream.

B. Description of the ASCM Design Procedure

1. List and justify values chosen for the watershed (or subwatershed) variables and model parameters (e.g., soils, sediment grain size distribution, slopes, etc.).

2. Where applicable, submit data used to calibrate model and the calibration results (e.g., design hydrographs, hyetographs, curve numbers, etc.).

3. Explain the choice of ASCM's.

4. Submit and justify the design storm recurrence interval and duration, runoff volume, and peak discharge.

5. Submit sample calculations and/or computer model output.

C. Provide a map of ASCM's on a mining sequence topographic map or overlay. Each ASCM should be referenced in the descriptive text and design information, and dates of construction or implementation of each ASCM should be given. This map should be updated in each Annual Report if modifications are made.

D. Provide specifications for each ASCM and a schematic diagram of each typical structure.

E. For reclaimed areas:

1. Refer to drainage basin and channel designs in reclamation plan:

a. Longitudinal profiles of reclaimed channels.

b. Typical reclaimed channel cross sections.

c. Reclaimed area contour map with 10' or less contour interval.

d. Justification of drainage basin design.

e. Reclaimed basin characteristics such as: relief ratio, drainage area, topsoil and spoil particle sizes, average channel slope. Include discussion of how reclaimed basins, slopes and channels are designed to minimize additional sediment yield to downstream areas.

2. Surface treatments (mulch, contour ripping).

3. Channel protection measures, if any.

F. Maintenance and inspection plan.

G. Monitoring plan and description of degradation analysis.

H. If any impounding structure is designed to retain more than 2.0 ac-ft of water, a WQD permit must be obtained.

I. ASCM's designed to control large disturbed watersheds (excluding isolated small areas) may need to be permitted through the State Engineer's Office (Form SW-1, Application to Appropriate Surface Water). The State Engineer's Office should be contacted directly to determine whether or not such a permit is required.

APPENDIX 1

Design Events for Temporary Structures

Exceedance of the design runoff is likely to result in destruction of in-channel ASCM's and in the remobilization of any stored sediment. Therefore, temporary structures should be designed for an event with some reasonably small probability of occurrence over the structure's lifetime.

Example:

The highest acceptable risk of structure failure during that structure's lifetime is 20%.

Table 1 shows event return periods for which the risk of failure (at least once) over a given number of years will be no greater than 20%. The return periods in Table 1 were calculated from the following equation:

$$P = 1 - (1-1/t)^{n}$$

where P is the probability that an event of return period t will be equaled or exceeded at least once during the course of n years (Linsley, Kohler and Paulhus, 1982).

Table 1 - Design Event Return Periods

Expected Lifetime of Structure (yrs)	2	5	7	10
Design Event Return Period (yrs)	10	25	33	50

Over any two-year period, a 10-year event has a 20% chance of being equaled or exceeded at least once. Therefore, based on the criterion of 20% acceptable risk of failure, the appropriate design storm for a structure intended to function for two years is the 10-year peak runoff, or predicted peak runoff from the 10-year rainfall. For structure lifetimes outside the range of those in Table 1, appropriate design storm return periods should be calculated in the same manner from the equation given above.

APPENDIX 2

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Appendix C: 19 NMAC 8.2, Subpart 20, Section 2009

Introduction

New Mexico's Mining and Minerals Division (MMD) enforces the state's federally approved SMCRA primacy program. BMP regulations for coal mining and reclamation operations in New Mexico may be found under 19 NMAC 8.2 Subpart 20 Section 2009 which addresses general requirements for minimizing changes to the prevailing hydrologic balance in both the permit and adjacent areas. Section 2009 of Subpart 20 is presented below:

19 NMAC 8.2.20.2009 HYDROLOGIC BALANCE: GENERAL REQUIREMENTS

2009.A Surface coal mining operations shall be planned and conducted to minimize changes to the prevailing hydrologic balance in both the permit and adjacent areas and prevent material damage outside of the permit area in order to prevent adverse changes in that balance that could result from those operations. [11-29-97]

2009.B Changes in water quality and quantity, in depth to ground water, and in the location of surface water drainage channels shall be minimized so that the approved postmining land use of the permit area is not adversely affected. [11-29-97]

2009.C In no case shall Federal and State water quality statutes, regulations, standards, or effluent limitations be violated. [11-29-97]

2009.D Operations shall be conducted to minimize water pollution and, where necessary, sediment ponds or other treatment facilities shall be used to control water pollution.

(1) Each person who conducts surface coal mining operations shall emphasize mining and reclamation practices that prevent or minimize water pollution. Methods listed in paragraph 2009.D(2) and (3) shall be capable of containing or treating all surface flow from the disturbed areas and shall be used in preference to the use of sediment ponds or water treatment facilities.

(2) Acceptable practices to control sediment and minimize water pollution include, but are not limited to:

(i) stabilizing disturbed areas through land shaping, berming, contour furrowing or regrading to final contour;

(ii) diverting runoff;

(iii) achieving quickly germinating and growing stands of temporary vegetation;

(iv) regulating channel velocity of water;

(v) lining drainage channels with rock or revegetation;

(vi) mulching;

(vii) selectively placing and sealing acid-forming and toxic-forming materials; and

(viii) selectively placing waste materials in backfill areas.

(3) In addition, unless demonstrated to the Director otherwise, all acceptable practices for controlling and minimizing water pollution at underground mines shall include, but not be limited to:

(i) designing mines to prevent gravity drainage of acid waters;

(ii) sealing all underground mine openings;

(iii) controlling subsidence; and

(iv) preventing acid mine drainage.

(4) If the practices listed in paragraph 2009.D(2) are not adequate to meet the requirements of paragraph 2009.D(1), the person who conducts surface coal mining operations shall comply with the requirements of Section 2010, unless the Director issues a waiver under paragraph 2009.E. [11-29-97]

2009.E The Director may waive the requirements of this Section for regraded areas if the operator can demonstrate to the Director that the runoff from the regraded area is as good as or better quality than the waters entering the permit area and erosion from the regraded area has been controlled to the satisfaction of the Director.

(1) To provide for baseline data for waters entering the permit area, the operator shall operate and maintain monitoring on all drainages leading into the permit area, in a manner approved by the Director, in order to obtain and evaluate occurrences and changes in water quality and quantity during the life of mining operations.

(2) In order to ensure that runoff from the regraded area is in no way a hazard to the environment of the adjacent areas, the waters draining off of the regraded area shall not:

(i) exceed the values of Total Suspended Solids, Iron, Manganese, pH and those parameters listed in paragraph 2009.E(3)(I) from the baseline analyses from the water entering the permit area;

(ii) create an increase in sediment load into the receiving streams;

(iii) create any environmental harm or threat to public health and safety; and

(iv) degrade, pollute or otherwise diminish the characteristics of existing streams and drainages so as to cause imminent environmental harm to fish and wildlife habitats.

(3) Baseline data shall be collected from waters in drainages entering the permit area and runoff from regraded areas shall be collected during any precipitation event that produces such runoff. The operator shall demonstrate to the Director that the runoff from the regraded area has as good as or better chemical quality than the baseline analyses from waters entering the permit area.

(i) In addition to paragraph 2009.E(2)(I), chemical analysis of the runoff from the regraded area and baseline data from waters entering the permit area shall include, but not limited to, the following parameters:

Arsenic (As)	Phosphorus (P)	Carbonate (CO3)
Boron (B)	Potassium (K)	Bicarbonate (HCO3)
Calcium (Ca)	Selenium (Se)	Nitrate (NO3)
Chloride	Sodium (Na)	Sulfate (SO4)
Cadmium (Cd)	Uranium (U)	Total Dissolved
Fluoride	Vanadium (V)	Solids (TDS)
Lead (Pb)	Radioactivity	Sodium Adsorption
Magnesium (Mg)	Radium Ra226	Ratio (SAR)
Radium Ra228		

(ii) The Director may require additional tests and analyses as he deems necessary.

(iii) If the operator can demonstrate that the analysis of any particular parameter are of little or not significance in the permit or adjacent areas, then such parameter(s) may be waived upon approval by the director.

APPENDIX D: Mine Modeling and Performance Analysis - Model Input and Output Data

Introduction

This Appendix contains model input and output data for the mine modeling performed for NMA using RUSLE version 1.06 and SEDCAD 4.0. This study was submitted to EPA as "DRAFT - Western Alkaline Mining Subcategory Mine Modeling and Performance-Cost-Benefit Analysis" in support of the Western Alkaline Mining Subcategory proposal (WCMWG, 1999c). These data and information support the sedimentology and hydrology modeling results presented in Section 6, Case Study 1 of this document. The supporting input and output data for the RUSLE modeling is presented first (Tables D-1 through D-6) followed by the SEDCAD output information (Exhibits D-1 through D-3)..

RUSLE Version 1.06 Modeling

Soil loss estimates from a representative model mine were developed using RUSLE version 1.06. The backup input and output data are summarized in table form here as:

- Table D-1: RUSLE Input Variables For Premining Subwatersheds
- Table D-2: Premining RUSLE Model Output
- Table D-3: RUSLE Input Variables For Reclaimed Subwatersheds
- Table D-4: Input And Output Variables For Reclaimed Areas
- Table D-5: Postmining Reclamation RUSLE Erosion Model Output
- Table D-6: Weighted Average Soil Loss Estimates For Disturbed and Reclaimed Subwatersheds (RUSLE)

SEDCAD Version 4.0 Modeling

Hydrology and sedimentology data were generated for the model mine under three scenarios: undisturbed (premining) conditions; reclamation under current 40 CFR Part 434 guidelines; and reclamation with alternative BMPs. The supporting reports as produced by SEDCAD for the three scenarios are presented in this Appendix:

- Exhibit D-1: Premining Undisturbed Conditions
- Exhibit D-2: Postmining Reclaimed Conditions, Existing Guidelines
- Exhibit D-3: Postmining Reclaimed Conditions, Proposed Subcategory

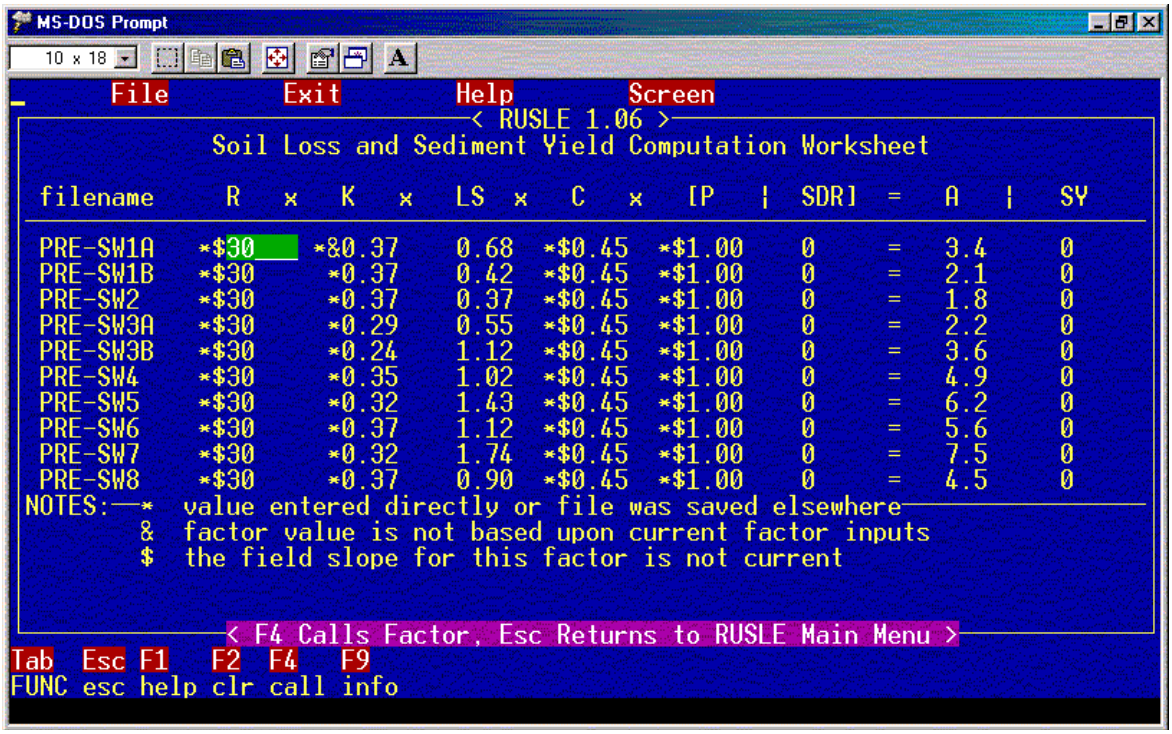
TABLE D-1: RUSLE Input Variables For Premining Subwatersheds

Reclaimed Watershed	Reclaimed Watershed Area (acres)	R	K	L	S	C	P	Composite Curve Number	Hydrologic Condition
SW3A	31.2	30	0.29	700	3.5	0.45	1.00	81	C
SW3B	15.5	30	0.24	435	5.0	0.45	1.00	79	B
SW7	25.9	30	0.32	500	10.0	0.45	0.47	88	D
SW9	290.0	30	0.24	425	7.0	0.45	1.00	77	B
SW10	14.0	30	0.32	500	6.7	0.45	1.00	90	D
SW11	15.0	30	0.35	275	7.1	0.45	1.00	91	D
SW13	105.3	30	0.27	390	6.7	0.45	1.00	81	C
SW14	9.3	30	0.32	300	5.4	0.45	1.00	88	D
SW15	30.520	30	0.32	160	12.5	0.45	1.00	88	D
SW17	78.5	30	0.36	375	7.6	0.45	1.00	92	D
Subtotal	**616.7**	**Acres for subwatershed that will contain 381.8 acres of mining disturbance.**							
SW1A	44.6	30	0.37	650	4.5	0.45	1.00	93	D
SW1B	140.1	30	0.37	800	3.0	0.45	1.00	93	D
SW2	104.1	30	0.37	850	2.5	0.45	1.00	93	D
SW4	75.3	30	0.35	350	7.0	0.45	1.00	92	D
SW5	5.5	30	0.32	190	10.0	0.45	1.00	88	D
SW6	26.1	30	0.37	250	8.0	0.45	1.00	93	D
SW8	23.8	30	0.37	315	6.3	0.45	1.00	93	D
SW12	72.6	30	0.37	360	8.3	0.45	1.00	93	D
SW16	55.9	30	0.33	440	8.2	0.45	1.00	92	D
SW18	23.3	30	0.32	375	7.0	0.45	1.00	88	D
Subtotal	**571.3**	**acres for subwatershed area that will not be disturbed by mining.**							
Total	**1188.0**	**acres**							

TABLE D-1: RUSLE Input Variables For Premining Subwatersheds (Continued)

Reclaimed Watershed	Soil Type	Surface Condition	Number of Years to Consolidate	General Land Use
SW3A	Loamy Sand	Undisturbed	7	6
SW3B	Loamy Sand	Undisturbed	7	6
SW7	Sandy Clay Loam	Undisturbed	7	6
SW9	Loamy Sand	Undisturbed	7	6
SW10	Sandy Clay Loam	Undisturbed	7	6
SW11	Sandy Clay Loam	Undisturbed	7	6
SW13	Loamy Sand	Undisturbed	7	6
SW14	Sandy Clay Loam	Undisturbed	7	6
SW15	Sandy Clay Loam	Undisturbed	7	6
SW17	Sandy Clay Loam	Undisturbed	7	6
SW1A	Sandy Clay Loam	Undisturbed	7	6
SW1B	Sandy Clay Loam	Undisturbed	7	6
SW2	Sandy Clay Loam	Undisturbed	7	6
SW4	Sandy Clay Loam	Undisturbed	7	6
SW5	Sandy Clay Loam	Undisturbed	7	6
SW6	Sandy Clay Loam	Undisturbed	7	6
SW8	Sandy Clay Loam	Undisturbed	7	6
SW12	Sandy Clay Loam	Undisturbed	7	6
SW16	Sandy Clay Loam	Undisturbed	7	6
SW18	Sandy Clay Loam	Undisturbed	7	6

TABLE D-2: Premining RUSLE Model Output



```
MS-DOS Prompt
10 x 18
File        Exit        Help        Screen
                    < RUSLE 1.06 >
          Soil Loss and Sediment Yield Computation Worksheet

 filename     R   x   K   x   LS  x   C   x   [P   ¦ SDR] =   A   ¦  SY

 PRE-SW1A   *$30    *&0.37    0.68   *$0.45   *$1.00    0     =   3.4     0
 PRE-SW1B   *$30     *0.37    0.42   *$0.45   *$1.00    0     =   2.1     0
 PRE-SW2    *$30     *0.37    0.37   *$0.45   *$1.00    0     =   1.8     0
 PRE-SW3A   *$30     *0.29    0.55   *$0.45   *$1.00    0     =   2.2     0
 PRE-SW3B   *$30     *0.24    1.12   *$0.45   *$1.00    0     =   3.6     0
 PRE-SW4    *$30     *0.35    1.02   *$0.45   *$1.00    0     =   4.9     0
 PRE-SW5    *$30     *0.32    1.43   *$0.45   *$1.00    0     =   6.2     0
 PRE-SW6    *$30     *0.37    1.12   *$0.45   *$1.00    0     =   5.6     0
 PRE-SW7    *$30     *0.32    1.74   *$0.45   *$1.00    0     =   7.5     0
 PRE-SW8    *$30     *0.37    0.90   *$0.45   *$1.00    0     =   4.5     0
NOTES:--*  value entered directly or file was saved elsewhere
        &  factor value is not based upon current factor inputs
        $  the field slope for this factor is not current

                < F4 Calls Factor, Esc Returns to RUSLE Main Menu >
Tab  Esc F1   F2  F4   F9
FUNC esc help clr call info
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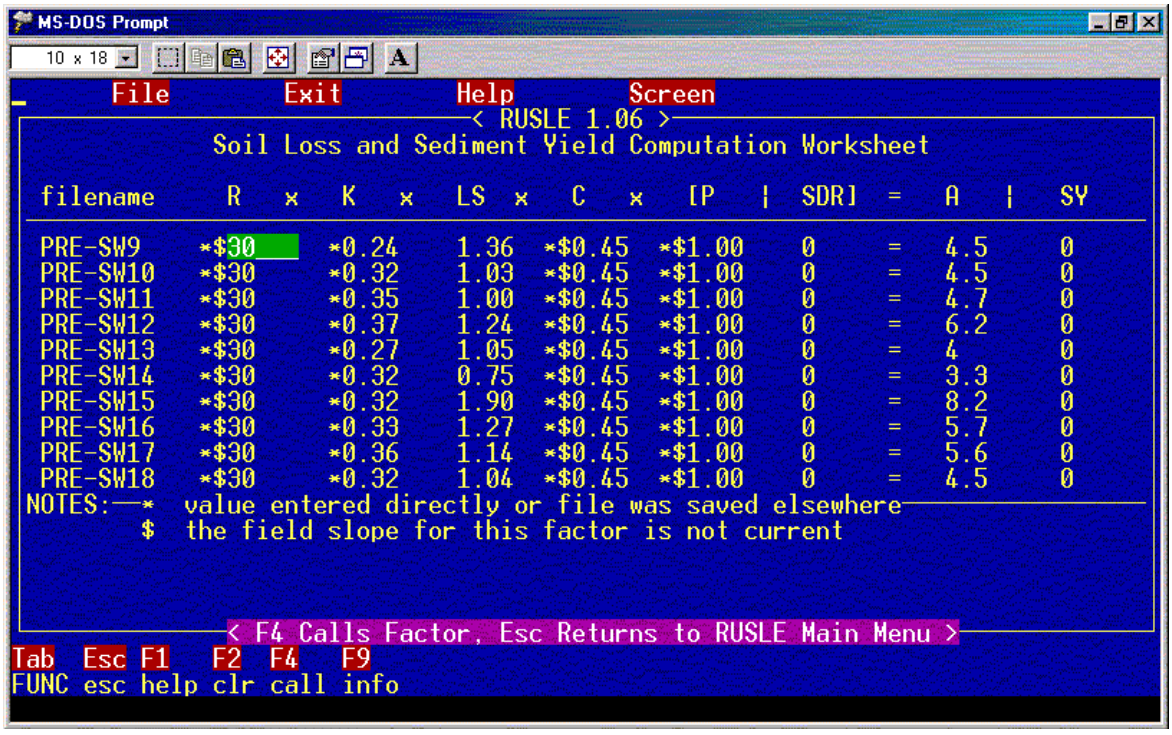


```
MS-DOS Prompt
10 x 18
File        Exit        Help        Screen
                    < RUSLE 1.06 >
          Soil Loss and Sediment Yield Computation Worksheet

 filename     R   x   K   x   LS  x   C   x   [P   ¦ SDR] =   A   ¦  SY

 PRE-SW9    *$30     *0.24    1.36   *$0.45   *$1.00    0     =   4.5     0
 PRE-SW10   *$30     *0.32    1.03   *$0.45   *$1.00    0     =   4.5     0
 PRE-SW11   *$30     *0.35    1.00   *$0.45   *$1.00    0     =   4.7     0
 PRE-SW12   *$30     *0.37    1.24   *$0.45   *$1.00    0     =   6.2     0
 PRE-SW13   *$30     *0.27    1.05   *$0.45   *$1.00    0     =   4       0
 PRE-SW14   *$30     *0.32    0.75   *$0.45   *$1.00    0     =   3.3     0
 PRE-SW15   *$30     *0.32    1.90   *$0.45   *$1.00    0     =   8.2     0
 PRE-SW16   *$30     *0.33    1.27   *$0.45   *$1.00    0     =   5.7     0
 PRE-SW17   *$30     *0.36    1.14   *$0.45   *$1.00    0     =   5.6     0
 PRE-SW18   *$30     *0.32    1.04   *$0.45   *$1.00    0     =   4.5     0
NOTES:--*  value entered directly or file was saved elsewhere
        $  the field slope for this factor is not current

                < F4 Calls Factor, Esc Returns to RUSLE Main Menu >
Tab  Esc F1   F2  F4   F9
FUNC esc help clr call info
```

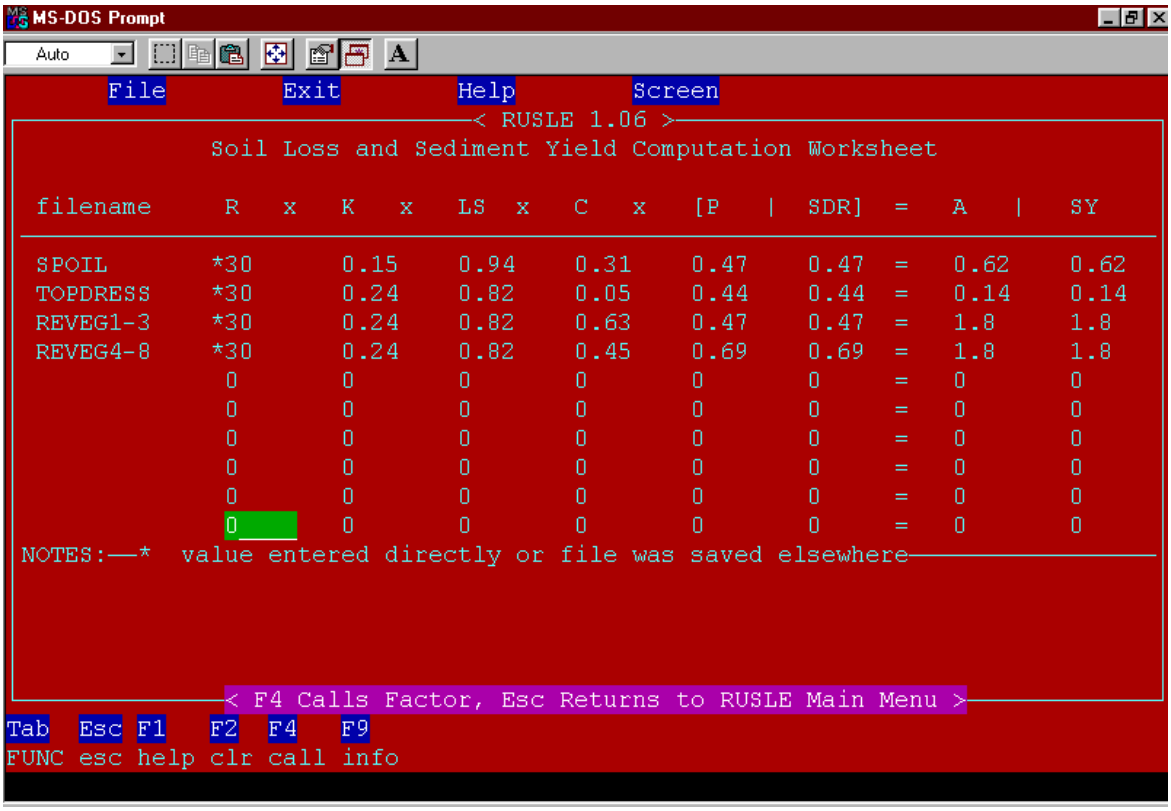
TABLE D-3: RUSLE Input Variables For Disturbed/Reclaimed Subwatersheds

Reclaimed Watershed	Reclaimed Watershed Area (acres)	R	K	L	S	C	P	Composite Curve Number	Hydrologic Condition
SW3A	20.295	30	0.29	650	7.0	0.45	1.00	80	B
SW3B	14.907	30	0.25	750	3.5	0.45	1.00	79	B
SW3C	8.414	30	0.24	250	11.0	0.45	1.00	79	B
SW3D	11.884	30	0.15	500	6.0	0.31	0.47	65	A
SW3E	5.500	30	0.29	450	6.0	0.05	0.44	74	B
SW3F	6.443	30	0.24	400	2.6	0.45	1.00	79	B
SW3G	14.513	30	0.24	475	5.0	0.63	0.45	74	B
SW3H	70.798	30	0.24	550	2.9	0.49	0.63	74	B
SW3I	8.314	30	0.24	250	8.2	0.45	1.00	79	B
SW7A	9.965	30	0.24	500	6.4	0.45	0.69	74	B
SW7B	11.735	30	0.32	125	8.0	0.45	1.00	88	D
SW9A	40.766	30	0.26	340	7.3	0.45	1.00	80	C
SW9B	7.113	30	6.3	250	6.0	0.31	0.47	65	A
SW9C	29.932	30	71.8	375	5.5	0.48	0.51	74	B
SW9D	9.575	30	36.4	400	6.4	0.45	0.69	74	B
SW9E	30.520	30	94.6	475	4.5	0.51	0.72	74	B
SW10	8.058	30	35.5	225	7.5	0.45	1.00	92	D
SW11A	15.142	30	59.1	500	6.0	0.45	0.69	74	B
SW11B	13.858	30	44.3	275	7.1	0.45	1.00	91	D
SW13A	22.100	30	57.5	500	5.0	0.45	1.00	79	B
SW13B	7.328	30	22.0	100	6.4	0.45	1.00	81	C
SW13C	13.158	30	12.8	450	5.0	0.31	0.47	65	A
SW13D	8.547	30	7.5	250	6.0	0.31	0.47	65	A
SW13E	13.831	30	13.4	250	5.0	0.30	0.45	74	B
SW13F	9.556	30	29.6	275	9.0	0.45	0.46	74	B
SW13G	16.221	30	50.3	375	6.6	0.55	0.47	74	B
SW13H	13.248	30	60.9	385	8.0	0.63	0.47	74	B
SW13I	12.053	30	35.0	375	5.3	0.49	0.63	74	B
SW13J	35.792	30	78.7	525	3.8	0.47	0.67	74	B
SW14A	5.974	30	16.1	300	5.4	0.45	0.69	74	B
SW14B	4.650	30	15.3	300	5.4	0.45	1.00	88	D
SW15A	15.352	30	64.5	375	7.2	0.45	0.69	74	B
SW15B	16.414	30	72.2	600	6.4	0.45	1.00	88	D
SW17A	3.038	30	11.5	100	6.5	0.45	1.00	93	D
SW17B	12.123	30	14.5	450	6.0	0.31	0.47	74	B
SW17C	8.741	30	8.3	450	6.0	0.18	0.45	74	B
SW17D	10.010	30	44.0	475	7.0	0.63	0.47	74	B
SW17E	50.821	30	264.3	375	7.0	0.45	1.00	92	D
Total	**616.7**								

TABLE D-3: RUSLE Input Variables For Disturbed/Reclaimed Subwatersheds (Continued)

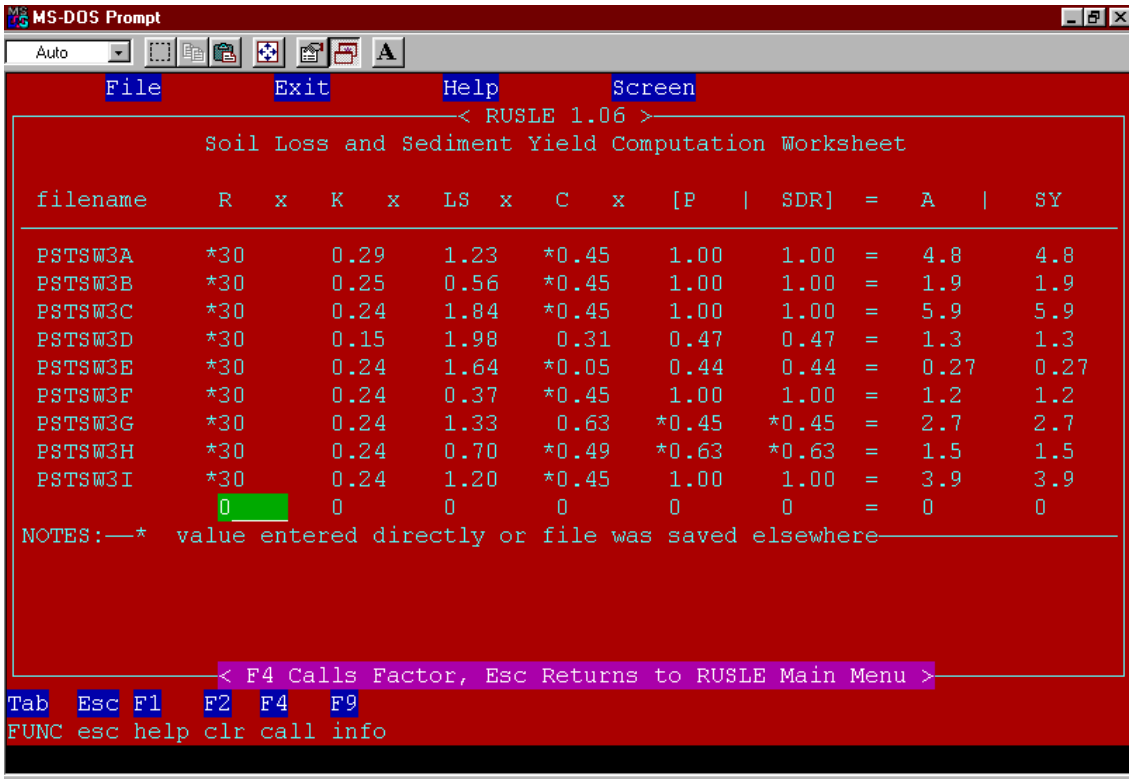
Reclaimed Watershed	Soil Type	Surface Comdition	Number of Years to Consolidate	General Land Use
SW3A	Loamy Sand	Undisturbed	7	6
SW3B	Loamy Sand	Undisturbed	7	6
SW3C	Loamy Sand	Undisturbed	7	6
SW3D	Loamy Sand	Spoil, backfilled & graded	10	10
SW3E	Loamy Sand	Topdressed, straw mulched & seeded	10	8
SW3F	Loamy Sand	Undisturbed	7	6
SW3G	Loamy Sand	Reveg. 1-3 Years	10	8
SW3H	Loamy Sand	Reveg. 4-8 years/some reveg. 1-3 years	10	8
SW3I	Loamy Sand	Undisturbed	7	6
SW7A	Loamy Sand	Reveg. 4-8 years	10	8
SW7B	Sandy Clay Loam	Undisturbed	7	6
SW9A	Loamy Sand	Undisturbed	7	6
SW9B	Loamy Sand	Spoil, backfilled & graded	10	10
SW9C	Loamy Sand	Reveg. 1-3 Years/some topdressed area	10	8
SW9D	Loamy Sand	Reveg. 4-8 years	10	8
SW9E	Loamy Sand	Reveg. 4-8 years/some 1-3 years/some undisturbed	10	8
SW10	Sandy Clay Loam	Undisturbed	7	6
SW11A	Loamy Sand	Reveg. 4-8 years	10	8
SW11B	Sandy Clay Loam	Undisturbed	7	6
SW13A	Loamy Sand	Undisturbed	7	6
SW13B	Loamy Sand	Undisturbed	7	6
SW13C	Loamy Sand	Spoil, backfilled & graded	10	10
SW13D	Loamy Sand	Spoil, backfilled & graded	10	10
SW13E	Loamy Sand	Topdressed/some reveg. 1-3 years	10	8
SW13F	Loamy Sand	Reveg. 1-3 Years/some topdressed area	10	8
SW13G	Loamy Sand	Reveg. 1-3 Years/some topdressed area	10	8
SW13H	Loamy Sand	Reveg. 1-3 Years/some reveg. 4-8 years	10	8
SW13I	Loamy Sand	Reveg. 4-8 Years/some reveg. 1-3 years	10	8
SW13J	Loamy Sand	Reveg. 4-8 Years/some reveg. 1-3 years	10	8
SW14A	Loamy Sand	Reveg. 4-8 Years	10	8
SW14B	Sandy Clay Loam	Undisturbed	7	6
SW15A	Loamy Sand	Reveg. 4-8 Years/some reveg. 1-3 years	10	8
SW15B	Sandy Clay Loam	Undisturbed	7	6
SW17A	Sandy Clay Loam	Undisturbed	7	6
SW17B	Loamy Sand	Spoil, backfilled & graded	10	10
SW17C	Loamy Sand	Topdressed/some reveg. 1-3 years	10	8
SW17D	Loamy Sand	Reveg. 1-3 years/some topdressed/some spoil	10	8
SW17E	Sandy Clay Loam	Undisturbed/some reclaimed	7	6

TABLE D-4: RUSLE Model Input And Output Variables For Reclaimed Areas



Area Filename	Description
SPOIL	Mine spoil backfilled and graded, consisting of loamy sand overburden; CN = 65; k = 0.15; hydrologic condition = A; 25% gravel, 10% cobble, 5% rock fragments; slow hydrologic response time.
TOPDRESS	Area topdressed, consisting of loamy sand topsoil; roughened with contour furrows; straw mulched (2 tons/acre); recently seeded with no growth started; CN = 74; k = 0.24; hydrologic condition = B; medium hydrologic response time.
REVEG1-3	Area originally prepared the same as previous topdressed area; 1-3 years of vegetative growth; surface roughening slightly decreased from erosion, sedimentation, and consolidation; CN = 74, k = 0.24; hydrologic condition = B; medium hydrologic response time.
REVEG1-4	Area originally prepared the same as previous topdressed area; 4-8 years of vegetative growth typically more dense than area with 1-3 years of vegetative growth; surface roughening continuing to decrease from erosion, sedimentation, and consolidation; CN = 74, k = 0.24; hydrologic condition = B; medium hydrologic response time.

TABLE D-5: Postmining Reclamation RUSLE Erosion Model Output



MS-DOS Prompt

Auto

File Exit Help Screen

< RUSLE 1.06 >

Soil Loss and Sediment Yield Computation Worksheet

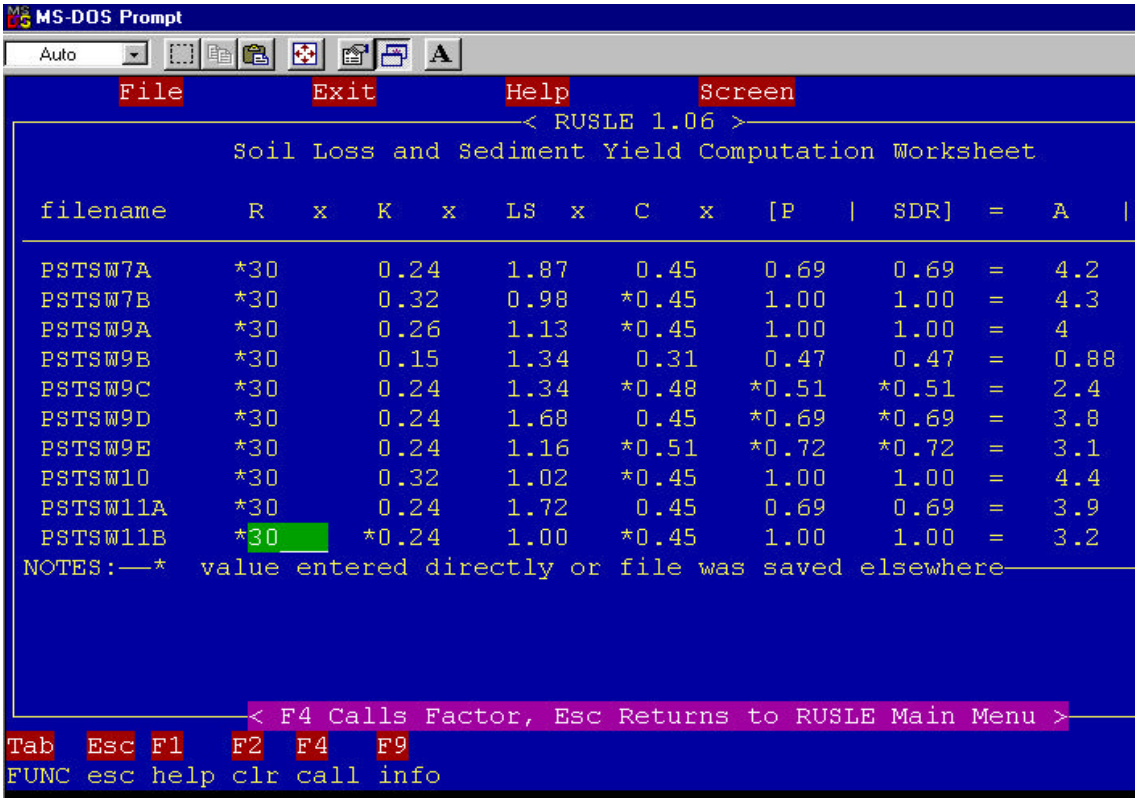
filename	R	x	K	x	LS	x	C	x	[P	SDR]	=	A	SY
PSTSW3A	*30		0.29		1.23		*0.45		1.00	1.00	=	4.8	4.8
PSTSW3B	*30		0.25		0.56		*0.45		1.00	1.00	=	1.9	1.9
PSTSW3C	*30		0.24		1.84		*0.45		1.00	1.00	=	5.9	5.9
PSTSW3D	*30		0.15		1.98		0.31		0.47	0.47	=	1.3	1.3
PSTSW3E	*30		0.24		1.64		*0.05		0.44	0.44	=	0.27	0.27
PSTSW3F	*30		0.24		0.37		*0.45		1.00	1.00	=	1.2	1.2
PSTSW3G	*30		0.24		1.33		0.63		*0.45	*0.45	=	2.7	2.7
PSTSW3H	*30		0.24		0.70		*0.49		*0.63	*0.63	=	1.5	1.5
PSTSW3I	*30		0.24		1.20		*0.45		1.00	1.00	=	3.9	3.9
	0		0		0		0		0	0	=	0	0

NOTES:—* value entered directly or file was saved elsewhere

< F4 Calls Factor, Esc Returns to RUSLE Main Menu >

Tab Esc F1 F2 F4 F9

FUNC esc help clr call info



MS-DOS Prompt

Auto

File Exit Help Screen

< RUSLE 1.06 >

Soil Loss and Sediment Yield Computation Worksheet

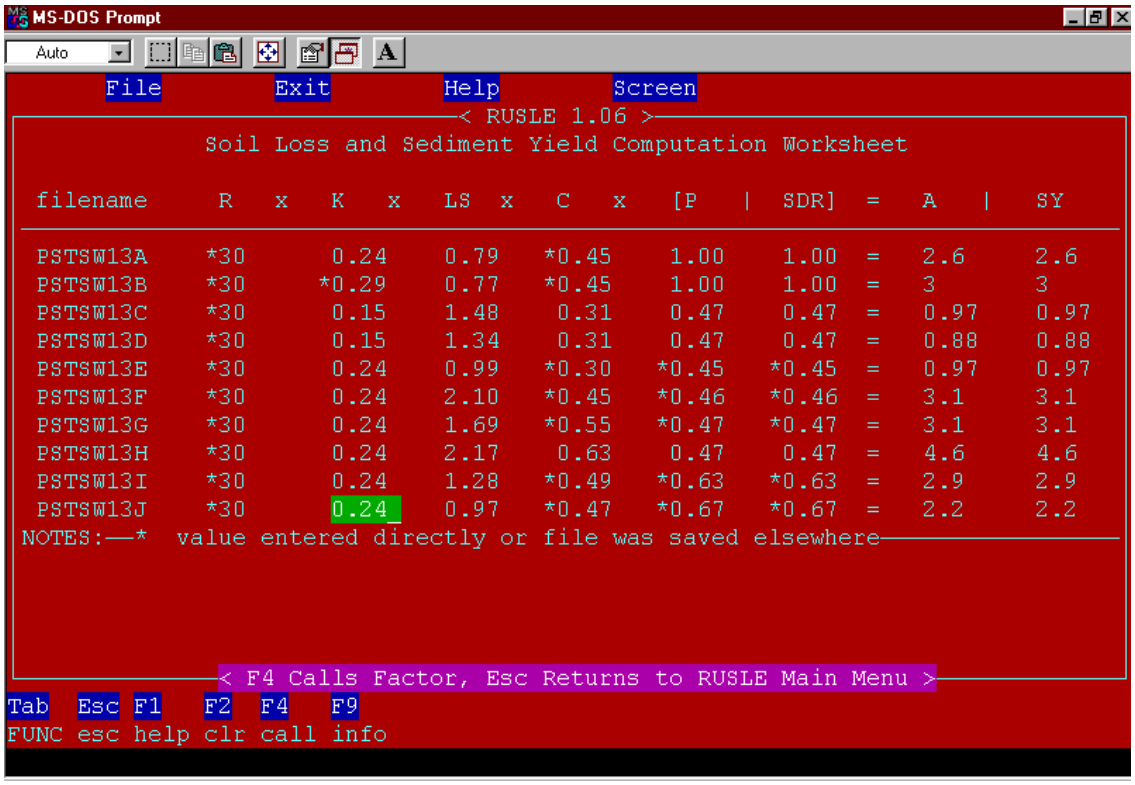
filename	R	x	K	x	LS	x	C	x	[P	SDR]	=	A
PSTSW7A	*30		0.24		1.87		0.45		0.69	0.69	=	4.2
PSTSW7B	*30		0.32		0.98		*0.45		1.00	1.00	=	4.3
PSTSW9A	*30		0.26		1.13		*0.45		1.00	1.00	=	4
PSTSW9B	*30		0.15		1.34		0.31		0.47	0.47	=	0.88
PSTSW9C	*30		0.24		1.34		*0.48		*0.51	*0.51	=	2.4
PSTSW9D	*30		0.24		1.68		0.45		*0.69	*0.69	=	3.8
PSTSW9E	*30		0.24		1.16		*0.51		*0.72	*0.72	=	3.1
PSTSW10	*30		0.32		1.02		*0.45		1.00	1.00	=	4.4
PSTSW11A	*30		0.24		1.72		0.45		0.69	0.69	=	3.9
PSTSW11B	*30	*0.24			1.00		*0.45		1.00	1.00	=	3.2

NOTES:—* value entered directly or file was saved elsewhere

< F4 Calls Factor, Esc Returns to RUSLE Main Menu >

Tab Esc F1 F2 F4 F9

FUNC esc help clr call info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Auto
File Exit Help Screen
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Soil Loss and Sediment Yield Computation Worksheet
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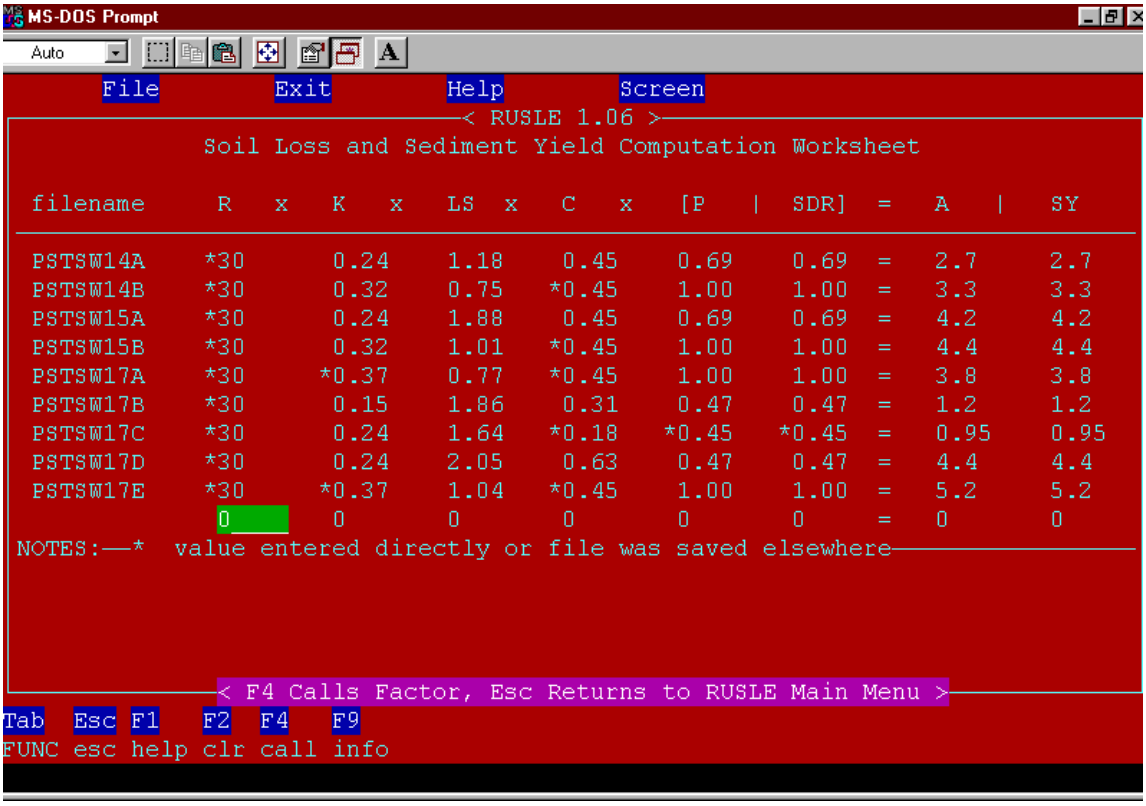
PSTSW13B *30 *0.29 0.77 *0.45 1.00 1.00 = 3 3
PSTSW13C *30 0.15 1.48 0.31 0.47 0.47 = 0.97 0.97
PSTSW13D *30 0.15 1.34 0.31 0.47 0.47 = 0.88 0.88
PSTSW13E *30 0.24 0.99 *0.30 *0.45 *0.45 = 0.97 0.97
PSTSW13F *30 0.24 2.10 *0.45 *0.46 *0.46 = 3.1 3.1
PSTSW13G *30 0.24 1.69 *0.55 *0.47 *0.47 = 3.1 3.1
PSTSW13H *30 0.24 2.17 0.63 0.47 0.47 = 4.6 4.6
PSTSW13I *30 0.24 1.28 *0.49 *0.63 *0.63 = 2.9 2.9
PSTSW13J *30 0.24 0.97 *0.47 *0.67 *0.67 = 2.2 2.2
NOTES:—* value entered directly or file was saved elsewhere
< F4 Calls Factor, Esc Returns to RUSLE Main Menu >
Tab Esc F1 F2 F4 F9
FUNC esc help clr call info


MS-DOS Prompt
Auto
File Exit Help Screen
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Soil Loss and Sediment Yield Computation Worksheet
filename R x K x LS x C x [P | SDR] = A | SY
PSTSW14A *30 0.24 1.18 0.45 0.69 0.69 = 2.7 2.7
PSTSW14B *30 0.32 0.75 *0.45 1.00 1.00 = 3.3 3.3
PSTSW15A *30 0.24 1.88 0.45 0.69 0.69 = 4.2 4.2
PSTSW15B *30 0.32 1.01 *0.45 1.00 1.00 = 4.4 4.4
PSTSW17A *30 *0.37 0.77 *0.45 1.00 1.00 = 3.8 3.8
PSTSW17B *30 0.15 1.86 0.31 0.47 0.47 = 1.2 1.2
PSTSW17C *30 0.24 1.64 *0.18 *0.45 *0.45 = 0.95 0.95
PSTSW17D *30 0.24 2.05 0.63 0.47 0.47 = 4.4 4.4
PSTSW17E *30 *0.37 1.04 *0.45 1.00 1.00 = 5.2 5.2
0 0 0 0 0 0 = 0 0
NOTES:—* value entered directly or file was saved elsewhere
< F4 Calls Factor, Esc Returns to RUSLE Main Menu >
Tab Esc F1 F2 F4 F9
FUNC esc help clr call info

TABLE D-6: Weighted Average Soil Loss Estimates For Undisturbed And Reclaimed Watersheds (RUSLE)

UNDISTURBED WATERSHED				RECLAIMED WATERSHED			
Undisturbed Watershed	**Undisturbed Watershed Area (acres)**	**Average Annual Soil Loss (tons/acre)**	**Average Annual Soil Loss (tons)**	**Reclaimed Watershed**	**Reclaimed Watershed Area (acres)**	**Average Annual Soil Loss (tons/acre)**	**Average Annual Soil Loss (tons)**
SW3A	31.2	2.2	68.7	SW3A	20.3	4.8	97.4
SW3B	15.5	3.6	55.8	SW3B	14.9	1.9	28.3
				SW3C	8.4	5.9	49.6
				SW3D	11.9	1.3	15.4
				SW3E	5.5	0.27	1.5
				SW3F	6.4	1.2	7.7
				SW3G	14.5	2.7	39.2
				SW3H	70.8	1.5	106.2
SW7	25.9	7.5	194.2	SW3I	8.3	3.9	32.4
				SW7A	10.0	4.2	41.9
				SW7B	11.7	4.3	50.5
SW9	290.0	4.5	1305.0	SW9A	40.8	4.0	163.1
				SW9B	7.1	0.88	6.3
				SW9C	29.9	2.4	71.8
				SW9D	9.6	3.8	36.4
				SW9E	30.5	3.1	94.6
SW10	14.0	4.5	63.1	SW10	8.1	4.4	35.5
SW11	15.0	4.7	70.6	SW11A	15.1	3.9	59.1
				SW11B	13.9	3.2	44.3
SW13	105.3	4.0	421.2	SW13A	22.1	2.6	57.5
				SW13B	7.3	3.0	22.0
				SW13C	13.2	0.97	12.8
				SW13D	8.5	0.88	7.5
				SW13E	13.8	0.97	13.4
				SW13F	9.6	3.1	29.6
				SW13G	16.2	3.1	50.3
				SW13H	13.2	4.6	60.9
				SW13I	12.1	2.9	35.0
				SW13J	35.8	2.2	78.7
SW14	9.3	3.3	30.7	SW14A	6.0	2.7	16.1
				SW14B	4.7	3.3	15.3
SW15	32.0	8.2	262.0	SW15A	15.4	4.2	64.5
				SW15B	16.4	4.4	72.2
SW17	78.5	5.6	439.6	SW17A	3.0	3.8	11.5
				SW17B	12.1	1.2	14.5
				SW17C	8.7	0.95	8.3
				SW17D	10.0	4.4	44.0
				SW17E	50.8	5.2	264.3
Totals	**616.7**		**2911.0**		**616.7**		**1859.8**
Weighted Average Soil Loss = 4.7 tons/acre/yr.				**Weighted Average Soil Loss = 3.0 tons/acre/yr.**			

Appendix D: Exhibit D-1

SEDCAD 4.0 Output

for

Premining Undisturbed Conditions

General Information

Storm Information:

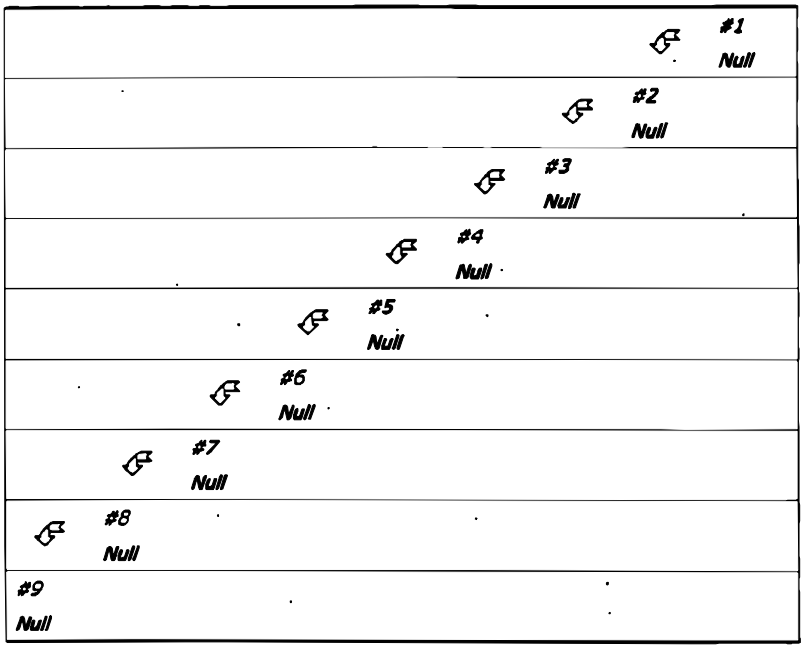
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution:

Size (mm)	psd1	psd2
2.0000	100.000%	100.000%
0.1000	83.500%	30.000%
0.0500	77.000%	17.000%
0.0020	56.000%	11.000%
0.0010	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.050	0.429	Structure #2
Null	#2	==>	#3	0.018	0.435	Structure #3
Null	#3	==>	#4	0.029	0.433	Structure #3
Null	#4	==>	#5	0.021	0.435	Structure #4
Null	#5	==>	#6	0.042	0.421	Structure #5
Null	#6	==>	#7	0.023	0.428	Structure #6
Null	#7	==>	#8	0.060	0.419	Structure #7
Null	#8	==>	#9	0.048	0.397	Structure #8
Null	#9	==>	End	0.000	0.000	Structure #9



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	9. Small streams flowing bankfull	1.30	24.00	1,847.57	10.25	0.050
#1	**Muskingum K:**					**0.050**
#2	9. Small streams flowing bankfull	1.60	12.00	751.55	11.37	0.018

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.018**
#3	9. Small streams flowing bankfull	1.47	17.00	1,153.01	10.92	0.029
#3	**Muskingum K:**					**0.029**
#4	9. Small streams flowing bankfull	1.58	14.00	887.93	11.30	0.021
#4	**Muskingum K:**					**0.021**
#5	9. Small streams flowing bankfull	1.01	14.00	1,386.68	9.04	0.042
#5	**Muskingum K:**					**0.042**
#6	9. Small streams flowing bankfull	1.27	11.00	866.89	10.13	0.023
#6	**Muskingum K:**					**0.023**
#7	9. Small streams flowing bankfull	0.95	18.00	1,900.33	8.75	0.060
#7	**Muskingum K:**					**0.060**
#8	9. Small streams flowing bankfull	0.53	6.00	1,139.38	6.53	0.048
#8	**Muskingum K:**					**0.048**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	288.818	288.818	244.26	27.26	1,477.1	86,019	15.54	8.32
#2	122.068	410.886	309.65	35.48	2,189.0	99,259	18.12	9.61
#3	31.628	442.514	327.01	38.31	2,489.4	99,890	19.13	10.46
#4	49.698	492.212	376.42	42.30	3,029.8	110,345	22.47	12.02
#5	304.024	796.236	429.48	51.82	3,872.1	120,640	34.36	17.72
#6	87.585	883.821	493.76	59.93	4,804.7	126,327	31.92	16.88
#7	114.620	998.441	558.68	64.65	5,250.4	144,849	41.43	19.11
#8	87.850	1,086.291	608.08	71.70	6,095.5	154,019	40.49	18.46
#9	102.240	1,188.531	679.09	80.01	7,004.2	155,091	38.22	17.89

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	44.593	0.121	0.104	0.440	93.000	M	50.25	4.209
	2	140.138	0.166	0.000	0.000	93.000	M	111.94	13.227
	3	104.087	0.165	0.000	0.000	93.000	M	83.14	9.824
	Σ	**288.818**						**244.26**	**27.260**
#2	1	31.234	0.128	0.016	0.449	81.000	M	10.57	1.254
	2	15.493	0.060	0.000	0.000	79.000	M	7.38	0.529
	3	75.341	0.172	0.000	0.000	91.500	M	54.68	6.433
	Σ	**410.886**						**309.65**	**35.476**
#3	1	5.514	0.044	0.000	0.000	88.000	M	4.81	0.371
	2	26.114	0.120	0.000	0.000	93.000	M	29.43	2.465
	Σ	**442.514**						**327.01**	**38.311**
#4	1	25.898	0.062	0.000	0.000	88.000	M	22.59	1.741
	2	23.800	0.082	0.000	0.000	93.000	M	26.82	2.246
	Σ	**492.212**						**376.42**	**42.299**
#5	1	289.995	0.245	0.000	0.000	77.100	M	57.78	8.416
	2	14.029	0.055	0.000	0.000	90.300	M	13.86	1.105
	Σ	**796.236**						**429.48**	**51.820**
#6	1	15.023	0.076	0.000	0.000	91.200	M	15.54	1.257
	2	72.562	0.282	0.000	0.000	93.000	M	51.41	6.849
	Σ	**883.821**						**493.76**	**59.925**
#7	1	105.300	0.056	0.000	0.000	80.600	M	56.78	4.095
	2	9.320	0.043	0.000	0.000	88.000	M	8.13	0.627
	Σ	**998.441**						**558.68**	**64.647**
#8	1	31.950	0.135	0.000	0.000	88.000	M	18.58	2.148
	2	55.900	0.221	0.000	0.000	91.900	M	39.48	4.903
	Σ	**1,086.291**						**608.08**	**71.698**
#9	1	78.950	0.128	0.000	0.000	91.500	M	57.57	6.741
	2	23.290	0.126	0.000	0.000	88.000	M	13.55	1.566
	Σ	**1,188.531**						**679.09**	**80.005**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.370	650.00	4.50	0.4500	1.0000	1	452.3	137,017	35.57	19.65
	2	0.370	800.00	3.00	0.4500	1.0000	1	633.3	78,397	11.44	6.17
	3	0.370	850.00	2.50	0.4500	1.0000	1	391.6	65,611	9.57	5.16
	Σ							**1,477.1**	**86,019**	**15.54**	**8.32**
#2	1	0.290	700.00	3.50	0.4500	1.0000	2	39.2	55,599	36.06	18.07
	2	0.240	435.00	5.00	0.4500	1.0000	2	28.3	84,199	57.70	26.44
	3	0.355	350.00	7.00	0.4500	1.0000	1	644.3	159,109	21.76	11.83
	Σ							**2,189.0**	**99,259**	**18.12**	**9.61**
#3	1	0.320	190.00	10.00	0.4500	1.0000	1	35.5	128,519	33.37	17.62
	2	0.370	250.00	8.00	0.4500	1.0000	1	266.5	137,773	35.77	19.77
	Σ							**2,489.4**	**99,890**	**19.13**	**10.46**
#4	1	0.320	500.00	10.00	0.4500	1.0000	1	326.0	239,271	62.12	33.22
	2	0.370	315.00	6.30	0.4500	1.0000	1	214.5	122,434	31.79	17.54
	Σ							**3,029.8**	**110,345**	**22.47**	**12.02**
#5	1	0.246	500.00	8.00	0.4500	1.0000	2	727.3	150,082	94.43	47.79
	2	0.320	500.00	6.70	0.4500	1.0000	1	115.1	135,948	35.30	19.09
	Σ							**3,872.1**	**120,640**	**34.36**	**17.72**
#6	1	0.350	275.00	7.10	0.4500	1.0000	1	113.1	117,339	30.46	16.57
	2	0.370	360.00	8.30	0.4500	1.0000	1	820.0	188,469	19.04	10.50
	Σ							**4,804.7**	**126,327**	**31.92**	**16.88**
#7	1	0.279	390.00	6.70	0.4500	1.0000	2	406.6	147,302	100.94	48.11
	2	0.320	300.00	5.40	0.4500	1.0000	1	39.2	85,371	22.16	11.65
	Σ							**5,250.4**	**144,849**	**41.43**	**19.11**
#8	1	0.320	160.00	12.50	0.4500	1.0000	1	274.3	201,561	24.88	13.43
	2	0.333	440.00	8.20	0.4500	1.0000	1	572.2	184,917	22.08	12.07
	Σ							**6,095.5**	**154,019**	**40.49**	**18.46**
#9	1	0.365	375.00	7.60	0.4500	1.0000	1	784.1	182,553	25.29	13.79
	2	0.320	375.00	7.00	0.4500	1.0000	1	124.8	129,681	16.01	8.56
	Σ							**7,004.2**	**155,091**	**38.22**	**17.89**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	4.71	30.00	636.28	4.370	0.040

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.49	57.00	1,634.92	5.600	0.081
#1	**1**	**Time of Concentration:**					**0.121**
#1	2	7. Paved area and small upland gullies	8.78	70.00	796.90	5.960	0.037
		8. Large gullies, diversions, and low flowing streams	3.22	29.00	901.46	5.380	0.046
		9. Small streams flowing bankfull	1.86	69.00	3,706.88	12.270	0.083
#1	**2**	**Time of Concentration:**					**0.166**
#1	3	7. Paved area and small upland gullies	3.12	38.00	1,216.03	3.550	0.095
		8. Large gullies, diversions, and low flowing streams	2.38	28.00	1,177.90	4.620	0.070
#1	**3**	**Time of Concentration:**					**0.165**
#2	1	7. Paved area and small upland gullies	3.04	27.00	887.69	3.510	0.070
		8. Large gullies, diversions, and low flowing streams	2.57	26.00	1,012.77	4.800	0.058
#2	**1**	**Time of Concentration:**					**0.128**
#2	2	7. Paved area and small upland gullies	3.27	20.00	611.13	3.640	0.046
		8. Large gullies, diversions, and low flowing streams	8.58	19.00	221.34	8.780	0.007
		9. Small streams flowing bankfull	3.00	13.00	433.36	15.580	0.007
#2	**2**	**Time of Concentration:**					**0.060**
#2	3	7. Paved area and small upland gullies	1.73	14.00	807.05	2.650	0.084
		8. Large gullies, diversions, and low flowing streams	3.19	29.00	908.12	5.360	0.047
		9. Small streams flowing bankfull	1.07	15.00	1,400.03	9.310	0.041
#2	**3**	**Time of Concentration:**					**0.172**
#3	1	7. Paved area and small upland gullies	7.32	43.00	587.07	5.440	0.029
		9. Small streams flowing bankfull	1.61	10.00	620.27	11.420	0.015
#3	**1**	**Time of Concentration:**					**0.044**
#3	2	7. Paved area and small upland gullies	2.34	15.00	640.64	3.080	0.057
		8. Large gullies, diversions, and low flowing streams	3.72	49.00	1,318.19	5.780	0.063
#3	**2**	**Time of Concentration:**					**0.120**
#4	1	7. Paved area and small upland gullies	7.59	20.00	263.53	5.540	0.013
		8. Large gullies, diversions, and low flowing streams	5.21	39.00	748.80	6.840	0.030
		9. Small streams flowing bankfull	2.29	22.00	959.65	13.620	0.019
#4	**1**	**Time of Concentration:**					**0.062**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	2	7. Paved area and small upland gullies	4.66	14.00	300.11	4.340	0.019
		8. Large gullies, diversions, and low flowing streams	4.06	56.00	1,378.22	6.040	0.063
#4	**2**	**Time of Concentration:**					**0.082**
#5	1	7. Paved area and small upland gullies	10.69	82.00	766.79	6.580	0.032
		8. Large gullies, diversions, and low flowing streams	3.21	88.00	2,739.55	5.370	0.141
		9. Small streams flowing bankfull	2.10	72.00	3,420.75	13.050	0.072
#5	**1**	**Time of Concentration:**					**0.245**
#5	2	7. Paved area and small upland gullies	5.10	34.00	666.96	4.540	0.040
		8. Large gullies, diversions, and low flowing streams	7.93	21.00	264.77	8.440	0.008
		9. Small streams flowing bankfull	1.59	5.00	315.33	11.330	0.007
#5	**2**	**Time of Concentration:**					**0.055**
#6	1	7. Paved area and small upland gullies	6.54	52.00	795.56	5.140	0.042
		9. Small streams flowing bankfull	1.11	13.00	1,174.34	9.460	0.034
#6	**1**	**Time of Concentration:**					**0.076**
#6	2	7. Paved area and small upland gullies	2.09	43.00	2,057.51	2.910	0.196
		8. Large gullies, diversions, and low flowing streams	2.77	43.00	1,551.00	4.990	0.086
#6	**2**	**Time of Concentration:**					**0.282**
#7	1	7. Paved area and small upland gullies	4.99	30.00	601.66	4.490	0.037
		9. Small streams flowing bankfull	6.74	110.00	1,630.98	23.370	0.019
#7	**1**	**Time of Concentration:**					**0.056**
#7	2	7. Paved area and small upland gullies	6.30	27.00	428.51	5.050	0.023
		8. Large gullies, diversions, and low flowing streams	10.22	34.00	332.75	9.580	0.009
		9. Small streams flowing bankfull	1.20	5.00	417.71	9.840	0.011
#7	**2**	**Time of Concentration:**					**0.043**
#8	1	7. Paved area and small upland gullies	4.21	34.00	807.08	4.130	0.054
		8. Large gullies, diversions, and low flowing streams	5.56	44.00	791.87	7.070	0.031
		9. Small streams flowing bankfull	0.94	15.00	1,591.17	8.730	0.050
#8	**1**	**Time of Concentration:**					**0.135**
#8	2	7. Paved area and small upland gullies	0.99	11.00	1,110.10	2.000	0.154
		8. Large gullies, diversions, and low flowing streams	5.86	104.00	1,774.62	7.260	0.067
#8	**2**	**Time of Concentration:**					**0.221**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	7. Paved area and small upland gullies	5.23	39.00	746.34	4.600	0.045
		8. Large gullies, diversions, and low flowing streams	5.43	114.00	2,097.55	6.990	0.083
#9	**1**	**Time of Concentration:**					**0.128**
#9	2	7. Paved area and small upland gullies	3.64	42.00	1,154.32	3.830	0.083
		8. Large gullies, diversions, and low flowing streams	3.64	26.00	714.95	5.720	0.034
		9. Small streams flowing bankfull	1.91	8.00	418.23	12.440	0.009
#9	**2**	**Time of Concentration:**					**0.126**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	9. Small streams flowing bankfull	1.94	91.00	4,701.50	12.520	0.104
#1	**1**	**Muskingum K:**					**0.104**
#2	1	9. Small streams flowing bankfull	2.82	26.00	923.06	15.100	0.016
#2	**1**	**Muskingum K:**					**0.016**

The average annual sediment yield numbers presented in Table 6b, in Section 6, were calculated by using the pond design feature in SEDCAD 4.0. By putting a fictitious pond at the bottom of the model, SEDCAD calculated the amount of sediment storage needed to store the sediment yield. The fictitious pond structure details along with the estimate of the sediment storage is presented on the following pages.

Structure Detail:

Structure #9 (Pond)

Structure #9

Pond Inputs:

Initial Pool Elev:	4,612.58
Initial Pool:	0.01 ac-ft
*Sediment Storage:	8.29 ac-ft
Dead Space:	20.00 %

**Sediment capacity based on Average Annual R of 30.0 for 1 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,625.00	50.00	2.00:1	2.00:1	40.00

Pond Results:

Peak Elevation:	4,625.31
H'graph Detention Time:	6.79 hrs
Pond Model:	CSTRS
Dewater Time:	0.63 days
Trap Efficiency:	100.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,612.58	1.977	0.000	0.000		Top of Sed. Storage
4,612.58	1.979	0.008	0.000		
4,613.00	2.113	0.867	0.000		
4,613.50	2.278	1.964	0.000		
4,614.00	2.450	3.146	0.000		
4,614.50	2.629	4.416	0.000		
4,615.00	2.813	5.776	0.000		
4,615.50	3.004	7.230	0.000		
4,616.00	3.200	8.780	0.000		
4,616.50	3.403	10.431	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,617.50	3.828	14.045	0.000		
4,618.00	4.050	16.014	0.000		
4,618.50	4.278	18.096	0.000		
4,619.00	4.513	20.294	0.000		
4,619.50	4.753	22.610	0.000		
4,620.00	5.000	25.048	0.000		
4,620.50	5.168	27.590	0.000		
4,621.00	5.339	30.216	0.000		
4,621.50	5.513	32.929	0.000		
4,622.00	5.689	35.730	0.000		
4,622.50	5.868	38.619	0.000		
4,623.00	6.050	41.598	0.000		
4,623.50	6.235	44.670	0.000		
4,624.00	6.423	47.834	0.000		
4,624.50	6.613	51.093	0.000		
4,625.00	6.806	54.447	0.000		Spillway #1
4,625.31	6.926	56.560	22.662	15.15	Peak Stage
4,625.50	7.002	57.899	37.027		
4,626.00	7.200	61.449	74.055		
4,626.50	7.402	65.100	171.123		
4,627.00	7.606	68.851	276.389		
4,627.50	7.813	72.706	408.617		
4,628.00	8.022	76.664	563.449		
4,628.50	8.235	80.728	745.101		
4,629.00	8.450	84.900	946.944		
4,629.50	8.668	89.179	1,168.597		
4,630.00	8.889	93.568	1,409.825		
4,630.50	9.113	98.069	1,670.496		
4,631.00	9.339	102.682	1,950.549		
4,631.50	9.568	107.408	2,249.978		
4,632.00	9.800	112.250	2,568.817		
4,632.50	10.035	117.209	2,907.132		
4,633.00	10.272	122.286	3,265.013		
4,633.50	10.513	127.482	3,603.927		
4,634.00	10.756	132.799	3,958.868		
4,634.50	11.001	138.238	4,372.167		
4,635.00	11.250	143.801	4,805.522		
4,635.50	11.501	149.489	5,259.089		
4,636.00	11.756	155.303	5,733.029		
4,636.50	12.013	161.245	6,227.508		
4,637.00	12.272	167.316	6,742.698		

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,616.00	0.000	0.000
4,616.50	0.000	0.000
4,617.00	0.000	0.000
4,617.50	0.000	0.000
4,618.00	0.000	0.000
4,618.50	0.000	0.000
4,619.00	0.000	0.000
4,619.50	0.000	0.000
4,620.00	0.000	0.000
4,620.50	0.000	0.000
4,621.00	0.000	0.000
4,621.50	0.000	0.000
4,622.00	0.000	0.000
4,622.50	0.000	0.000
4,623.00	0.000	0.000
4,623.50	0.000	0.000
4,624.00	0.000	0.000
4,624.50	0.000	0.000
4,625.00	0.000	0.000
4,625.50	37.027	37.027
4,626.00	74.055	74.055
4,626.50	171.123	171.123
4,627.00	276.389	276.389
4,627.50	408.617	408.617
4,628.00	563.449	563.449
4,628.50	745.101	745.101
4,629.00	946.944	946.944
4,629.50	1,168.597	1,168.597
4,630.00	1,409.825	1,409.825
4,630.50	1,670.496	1,670.496
4,631.00	1,950.549	1,950.549
4,631.50	2,249.978	2,249.978
4,632.00	2,568.817	2,568.817
4,632.50	2,907.132	2,907.132
4,633.00	3,265.013	3,265.013
4,633.50	3,603.927	3,603.927
4,634.00	3,958.868	3,958.868
4,634.50	4,372.167	4,372.167
4,635.00	4,805.522	4,805.522
4,635.50	5,259.089	5,259.089

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,636.00	5,733.029	5,733.029
4,636.50	6,227.508	6,227.508
4,637.00	6,742.698	6,742.698
4,637.50	7,278.774	7,278.774
4,638.00	7,835.915	7,835.915
4,638.50	8,414.301	8,414.301
4,639.00	9,014.114	9,014.114
4,639.50	9,635.539	9,635.539
4,640.00	10,278.760	10,278.760
4,640.50	10,943.960	10,943.960
4,641.00	11,631.330	11,631.330
4,641.50	12,341.060	12,341.060
4,642.00	13,073.320	13,073.320
4,642.50	13,828.310	13,828.310
4,643.00	14,606.220	14,606.220
4,643.50	15,407.220	15,407.220
4,644.00	16,231.500	16,231.500
4,644.50	17,079.260	17,079.260
4,645.00	17,950.660	17,950.660
4,645.50	18,845.900	18,845.900
4,646.00	19,765.160	19,765.160
4,646.50	20,708.610	20,708.610
4,647.00	21,676.450	21,676.450
4,647.50	22,668.840	22,668.840
4,648.00	23,685.980	23,685.980
4,648.50	24,728.020	24,728.020
4,649.00	25,795.160	25,795.160
4,649.50	26,887.570	26,887.570
4,650.00	28,005.420	28,005.420

Appendix D: Exhibit D-2

SEDCAD 4.0 Output

for

Postmining Reclaimed Conditions; Existing Guidelines

General information

Storm Information.-

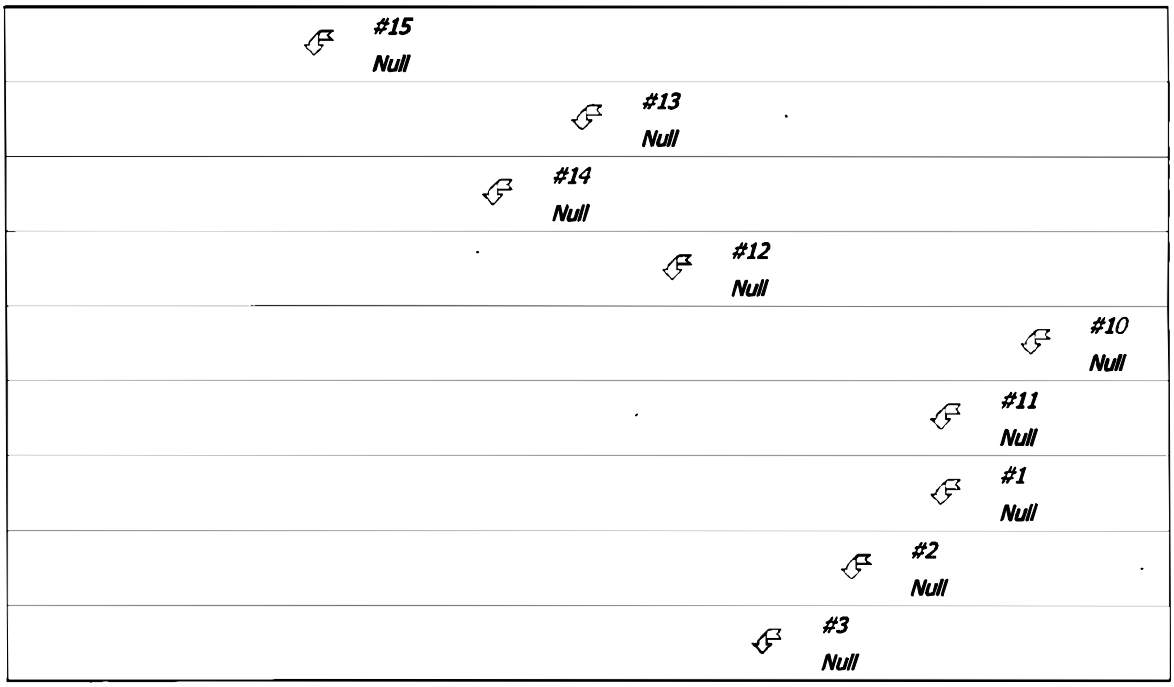
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution -

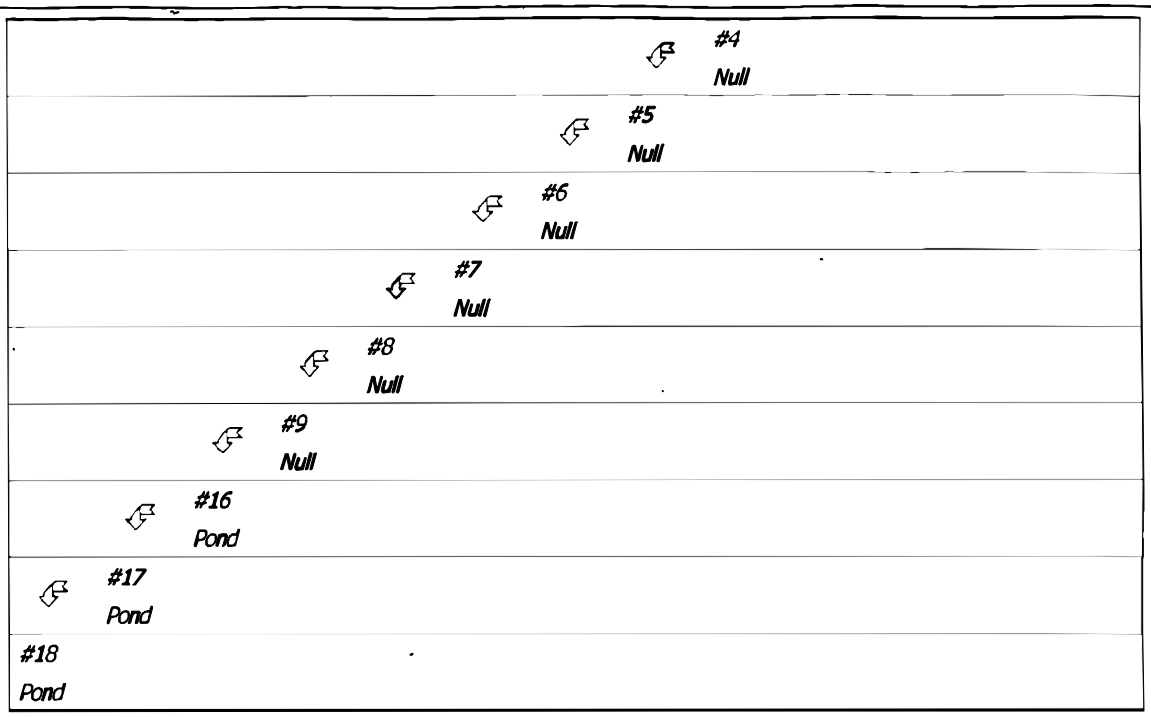
Size (mm)	psd I	psd2	psd3	psd4
2.0000	100.000%	100.000%	60.000%	100.000%
0.1000	83.500%	**30.000%**	15.900%	**26.500%**
0.0500	**77.000%**	**17.000%**	8.400%	**14.000%**
0.0020	56.000%	**11.000%**	6.600%	**11.000%**
0.0010				

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.050	0.429	Structure #2
Null	#2	==>	#3	0.018	0.435	Structure #3
Null	#3	==>	#4	0.029	0.433	Structure #3
Null	#4	==>	#5	0.011	0.445	Structure #4
Null	#5	==>	#6	0.057	0.414	Structure #5
Null	#6	==>	#7	0.023	0.428	Structure #6
Null	#7	==>	#8	0.060	0.419	Structure #7
Null	#8	==>	#9	0.048	0.397	Structure #8
Null	#9	==>	#16	0.000	0.000	Structure #9
Null	#10	==>	#11	0.027	0.448	Structure #10
Null	#11	==>	#2	0.075	0.435	Structure #11
Null	#12	==>	#5	0.029	0.449	Structure #12
Null	#13	==>	#14	0.019	0.449	Structure #13
Null	#14	==>	#7	0.038	0.447	Structure #14
Null	#15	==>	#9	0.051	0.449	Structure #15
Pond	#16	==>	#17	0.000	0.000	Pond #1
Pond	#17	==>	#18	0.000	0.000	Pond #2
Pond	#18	==>	End	0.000	0.000	Pond #3



Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#11	9. Small streams flowing bankfull	1.58	49.00	3,097.14	11.32	0.075
#11	**Muskingum K:**					**0.075**
#12	9. Small streams flowing bankfull	2.80	45.00	1,609.09	15.05	0.029
#12	**Muskingum K:**					**0.029**
#13	9. Small streams flowing bankfull	2.79	30.00	1,076.50	15.02	0.019
#13	**Muskingum K:**					**0.019**
#14	9. Small streams flowing bankfull	2.52	50.00	1,981.84	14.29	0.038
#14	**Muskingum K:**					**0.038**
#15	9. Small streams flowing bankfull	2.82	79.00	2,798.44	15.12	0.051
#15	**Muskingum K:**					**0.051**



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	9. Small streams flowing bankfull	1.30	24.00	1,847.57	10.25	0.050
#1	**Muskingum K:**					**0.050**
#2	9. Small streams flowing bankfull	1.60	12.00	751.55	11.37	0.018
#2	**Muskingum K:**					**0.018**
#3	9. Small streams flowing bankfull	1.47	17.00	1,153.01	10.92	0.029
#3	**Muskingum K:**					**0.029**
#4	9. Small streams flowing bankfull	2.38	14.00	587.93	13.88	0.011
#4	**Muskingum K:**					**0.011**
#5	9. Small streams flowing bankfull	0.83	14.00	1,686.68	8.19	0.057
#5	**Muskingum K:**					**0.057**
#6	9. Small streams flowing bankfull	1.27	11.00	866.89	10.13	0.023
#6	**Muskingum K:**					**0.023**
#7	9. Small streams flowing bankfull	0.95	18.00	1,900.33	8.75	0.060
#7	**Muskingum K:**					**0.060**
#8	9. Small streams flowing bankfull	0.53	6.00	1,139.38	6.53	0.048
#8	**Muskingum K:**					**0.048**
#10	9. Small streams flowing bankfull	2.66	38.00	1,428.73	14.67	0.027
#10	**Muskingum K:**					**0.027**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#15		33.912	33.912	7.52	0.78	24.3	56,094	25.64	10.88
#13		74.497	74.497	17.08	1.68	64.2	73,318	50.27	19.19
#14		41.522	116.019	23.22	2.59	89.8	98,626	66.96	17.97
#12		87.386	87.386	33.10	2.42	154.0	99,183	68.21	30.77
#10		35.153	35.153	13.16	1.26	96.9	142,562	96.84	40.22
#11		46.192	81.345	23.03	2.28	145.4	121,806	82.73	33.13
#1		288.818	288.818	244.26	27.26	1,477.1	86,019	15.54	8.32
#2		154.453	524.616	320.56	37.80	2,313.0	103,515	21.70	10.80
#3		31.628	556.244	354.80	40.64	2,615.0	102,682	22.12	11.53
#4		45.500	601.744	394.83	43.89	2,886.8	101,460	22.43	11.94
#5		38.578	727.708	445.51	47.66	3,130.5	102,214	25.60	13.38
#6		101.562	829.270	493.50	56.00	4,068.0	111,723	24.80	13.17
#7		46.416	991.705	522.07	59.81	4,196.6	108,988	25.53	13.35
#8		87.666	1,079.371	555.78	66.15	4,906.1	115,962	25.84	13.44
#9		75.240	1,188.523	601.89	72.93	5,611.1	114,800	25.86	13.96
#16	In	0.000	1,188.523	601.89	72.93	5,611.1	114,800	25.86	13.96
	Out			388.93	58.44	2,665.9	53,621	0.00	0.00
#17	In	0.000	1,188.523	388.93	72.93	2,665.9	53,602	0.00	0.00
	Out			144.52	54.68	1,515.9	37,656	0.00	0.00
#18	In	0.000	1,188.523	144.52	72.93	1,515.9	37,643	0.00	0.00
	Out			44.79	48.83	666.1	28,235	0.00	0.00

Pond #1

Pond Inputs:

Initial Pool Elev:	4,620.80
Initial Pool:	0.01 ac-ft
*Sediment Storage:	6.70 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,625.50	20.00	2.00:1	2.00:1	50.00

Pond Results:

Peak Elevation:	4,627.49
H'graph Detention Time:	1.38 hrs
Pond Model:	CSTRS
Dewater Time:	1.30 days
Trap Efficiency:	52.49 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,620.80	1.842	0.000	0.000		Top of Sed. Storage
4,620.80	1.843	0.008	0.000		
4,620.81	1.847	0.027	0.000		
4,621.00	1.909	0.384	0.000		
4,621.50	2.080	1.381	0.000		
4,622.00	2.257	2.465	0.000		
4,622.50	2.442	3.639	0.000		

Design

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,623.00	2.633	4.907	0.000		
4,623.50	2.832	6.273	0.000		
4,624.00	3.039	7.741	0.000		
4,624.50	3.252	9.314	0.000		
4,625.00	3.473	10.995	0.000		
4,625.50	3.701	12.788	0.000		Spillway #1
4,625.75	3.818	13.728	4.504	17.15	
4,626.00	3.937	14.697	9.008	1.90	
4,626.50	4.179	16.726	117.195	11.25	
4,627.00	4.429	18.878	236.895	0.45	
4,627.49	4.683	21.126	388.930	0.35	Peak Stage
4,627.50	4.686	21.156	391.002		
4,628.00	4.950	23.565	572.058		
4,628.50	5.222	26.108	778.237		
4,629.00	5.501	28.788	1,008.372		
4,629.50	5.787	31.610	1,261.680		
4,630.00	6.080	34.576	1,537.619		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,620.80	0.000	0.000
4,620.80	0.000	0.000
4,620.81	0.000	0.000
4,621.00	0.000	0.000
4,621.50	0.000	0.000
4,622.00	0.000	0.000
4,622.50	0.000	0.000
4,623.00	0.000	0.000
4,623.50	0.000	0.000
4,624.00	0.000	0.000
4,624.50	0.000	0.000
4,625.00	0.000	0.000
4,625.50	0.000	0.000
4,625.75	4.504	4.504
4,626.00	9.008	9.008
4,626.50	117.195	117.195

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,603.50	0.000	0.000
4,603.75	0.000	0.000
4,604.00	0.000	0.000
4,604.50	7.214	7.214
4,605.00	94.261	94.261
4,605.50	191.122	191.122
4,606.00	316.440	316.440
4,606.50	464.388	464.388
4,607.00	633.655	633.655
4,607.50	823.441	823.441
4,608.00	1,033.244	1,033.244
4,608.50	1,262.749	1,262.749
4,609.00	1,511.766	1,511.766
4,609.50	1,780.193	1,780.193
4,610.00	2,067.994	2,067.994

Structure #18 (Pond)

Pond #3

Pond Inputs:

Initial Pool Elev:	4,580.88
Initial Pool:	0.02 ac-ft
*Sediment Storage:	6.70 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,586.50	20.00	2.00:1	2.00:1	30.00

Pond Results:

Peak Elevation:	4,587.30
H'graph Detention Time:	3.42 hrs
Pond Model:	CSTRS
Dewater Time:	0.68 days
Trap Efficiency:	56.06 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,627.00	236.895	236.895
4,627.50	391.002	391.002
4,628.00	572.058	572.058
4,628.50	778.237	778.237
4,629.00	1,008.372	1,008.372
4,629.50	1,261.680	1,261.680
4,630.00	1,537.619	1,537.619

Structure #17 (Pond)

Pond #2

Pond Inputs:

Initial Pool Elev:	4,599.52
Initial Pool:	0.03 ac-ft
*Sediment Storage:	6.70 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Pond Results:

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,599.51	2.099	0.000	0.000		Top of Sed. Storage
4,599.52	2.105	0.028	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,600.00	2.320	1.089	0.000		
4,600.50	2.469	2.286	0.000		
4,601.00	2.623	3.559	0.000		
4,601.50	2.782	4.911	0.000		
4,602.00	2.945	6.342	0.000		
4,602.50	3.113	7.857	0.000		
4,603.00	3.286	9.456	0.000		
4,603.50	3.463	11.144	0.000		
4,603.75	3.554	12.021	0.000		
4,604.00	3.645	12.921	0.000		Spillway #1
4,604.50	3.832	14.790	7.214	3.14*	
4,605.00	4.023	16.753	94.261	11.70	
4,605.26	4.126	17.822	144.525	0.60	Peak Stage
4,605.50	4.219	18.813	191.122		
4,606.00	4.419	20.973	316.440		
4,606.50	4.624	23.233	464.388		
4,607.00	4.834	25.598	633.655		
4,607.50	5.048	28.068	823.441		
4,608.00	5.267	30.647	1,033.244		
4,608.50	5.491	33.336	1,262.749		
4,609.00	5.719	36.139	1,511.766		
4,609.50	5.952	39.057	1,780.193		
4,610.00	6.190	42.092	2,067.994		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,599.51	0.000	0.000
4,599.52	0.000	0.000
4,600.00	0.000	0.000
4,600.50	0.000	0.000
4,601.00	0.000	0.000
4,601.50	0.000	0.000
4,602.00	0.000	0.000
4,602.50	0.000	0.000
4,603.00	0.000	0.000

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,580.87	1.720	0.000	0.000		Top of Sed. Storage
4,580.88	1.722	0.018	0.000		
4,581.00	1.744	0.226	0.000		
4,581.50	1.833	1.120	0.000		
4,582.00	1.926	2.060	0.000		
4,582.50	2.020	3.046	0.000		
4,583.00	2.117	4.080	0.000		
4,583.50	2.216	5.164	0.000		
4,584.00	2.318	6.297	0.000		
4,584.50	2.421	7.482	0.000		
4,585.00	2.527	8.718	0.000		
4,585.50	2.635	10.009	0.000		
4,586.00	2.745	11.354	0.000		
4,586.50	2.858	12.755	0.000		Spillway #1
4,587.00	2.973	14.212	5.419	3.25*	
4,587.30	3.044	15.118	44.786	12.95	Peak Stage
4,587.50	3.090	15.728	71.329		
4,588.00	3.210	17.303	145.356		
4,588.50	3.331	18.938	241.897		
4,589.00	3.455	20.635	356.760		
4,589.50	3.582	22.394	489.149		
4,590.00	3.710	24.217	638.637		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,580.87	0.000	0.000
4,580.88	0.000	0.000
4,581.00	0.000	0.000
4,581.50	0.000	0.000
4,582.00	0.000	0.000
4,582.50	0.000	0.000
4,583.00	0.000	0.000
4,583.50	0.000	0.000
4,584.00	0.000	0.000

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,584.50	0.000	0.000
4,585.00	0.000	0.000
4,585.50	0.000	0.000
4,586.00	0.000	0.000
4,586.50	0.000	0.000
4,587.00	5.419	5.419
4,587.50	71.329	71.329
4,588.00	145.356	145.356
4,588.50	241.897	241.897
4,589.00	356.760	356.760
4,589.50	489.149	489.149
4,590.00	638.637	638.637

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#15	1	3.038	0.100	0.065	0.378	93.000	M	3.42	0.287
	2	12.123	0.100	0.023	0.396	65.000	S	0.50	0.086
	3	8.741	0.100	0.000	0.000	74.000	M	2.61	0.190
	4	10.010	0.147	0.000	0.000	74.000	M	1.56	0.218
	Σ	**33.912**						**7.52**	**0.781**
#13	1	22.100	0.085	0.016	0.455	79.000	M	10.53	0.755
	2	10.547	0.020	0.000	0.000	65.000	S	0.43	0.075
	3	7.328	0.017	0.191	0.316	81.000	M	4.07	0.294
	4	13.158	0.033	0.158	0.301	65.000	S	0.54	0.094
	5	13.826	0.231	0.000	0.000	74.000	M	1.89	0.301
	6	7.538	0.073	0.000	0.000	74.000	M	2.25	0.164
	Σ	**74.497**						**17.08**	**1.683**
#14	1	16.221	0.036	0.000	0.000	74.000	M	4.85	0.353
	2	13.248	0.388	0.000	0.000	74.000	M	1.40	0.288
	3	12.053	0.250	0.000	0.000	74.000	M	1.59	0.262
	Σ	**116.019**						**23.22**	**2.586**
#12	1	40.766	0.116	0.048	0.442	80.000	M	21.01	1.511
	2	7.113	0.014	0.035	0.444	65.000	S	0.29	0.051
	3	29.932	0.057	0.000	0.000	74.000	M	8.94	0.651
	4	9.575	0.080	0.000	0.000	74.000	M	2.86	0.208
	Σ	**87.386**						**33.10**	**2.421**
#10	1	20.295	0.065	0.000	0.000	80.000	M	10.46	0.752
	2	14.858	0.237	0.000	0.000	79.000	M	3.68	0.507
	Σ	**35.153**						**13.16**	**1.259**
#11	1	8.414	0.019	0.020	0.436	79.000	M	4.01	0.287
	2	11.322	0.041	0.007	0.431	65.000	S	0.47	0.081
	3	5.500	0.053	0.000	0.000	74.000	M	1.64	0.120
	4	14.513	0.304	0.000	0.000	74.000	M	1.75	0.316
	5	6.443	0.122	0.000	0.000	79.000	M	3.07	0.220
	Σ	**81.345**						**23.03**	**2.283**
#1	1	44.593	0.121	0.104	0.440	93.000	M	50.25	4.209
	2	140.138	0.166	0.000	0.000	93.000	M	111.94	13.227
	3	104.087	0.165	0.000	0.000	93.000	M	83.14	9.824

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**288.818**						**244.26**	**27.260**
#2	1	70.798	0.114	0.011	0.451	74.000	M	21.15	1.541
	2	8.314	0.039	0.000	0.000	79.000	M	3.96	0.284
	3	75.341	0.172	0.000	0.000	91.500	M	54.68	6.433
	Σ	**524.616**						**320.56**	**37.800**
#3	1	5.514	0.044	0.000	0.000	88.000	M	4.81	0.371
	2	26.114	0.120	0.000	0.000	93.000	M	29.43	2.465
	Σ	**556.244**						**354.80**	**40.636**
#4	1	11.735	0.046	0.000	0.000	88.000	M	10.24	0.789
	2	23.800	0.082	0.000	0.000	93.000	M	26.82	2.246
	3	9.965	0.023	0.012	0.385	74.000	M	2.98	0.217
	Σ	**601.744**						**394.83**	**43.888**
#5	1	8.058	0.037	0.000	0.000	91.500	M	8.46	0.688
	2	30.520	0.078	0.000	0.000	74.000	M	9.12	0.664
	Σ	**727.708**						**445.51**	**47.662**
#6	1	72.562	0.282	0.000	0.000	93.000	M	51.41	6.849
	2	13.858	0.062	0.000	0.000	91.200	M	14.34	1.160
	3	15.142	0.027	0.016	0.377	74.000	M	4.52	0.330
	Σ	**829.270**						**493.50**	**55.999**
#7	1	5.974	0.100	0.000	0.000	74.000	M	1.78	0.130
	2	4.650	0.100	0.000	0.000	88.000	M	4.06	0.313
	3	35.792	0.052	0.000	0.000	74.000	M	10.69	0.779
	Σ	**991.705**						**522.07**	**59.807**
#8	1	55.900	0.221	0.000	0.000	91.900	M	39.48	4.903
	2	15.352	0.067	0.037	0.411	74.000	M	4.59	0.334
	3	16.414	0.080	0.000	0.000	88.000	M	14.32	1.104
	Σ	**1,079.371**						**555.78**	**66.148**
#9	1	51.950	0.081	0.000	0.000	91.500	M	54.54	4.436
	2	23.290	0.126	0.000	0.000	88.000	M	13.55	1.566
	Σ	**1,188.523**						**601.89**	**72.930**
#16	**Σ**	**1,188.523**						**601.89**	**72.930**
#17	**Σ**	**1,188.523**						**388.93**	**72.930**
#18	**Σ**	**1,188.523**						**144.52**	**72.930**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#15	1	0.370	100.00	6.50	0.4500	1.0000	1	12.4	57,526	14.94	8.13
	2	0.150	450.00	6.00	0.3100	0.4700	3	0.6	10,413	7.70	3.50
	3	0.240	450.00	6.00	0.1800	0.4500	4	1.9	18,279	12.77	5.24
	4	0.240	475.00	9.00	0.6300	0.4700	4	9.3	80,383	52.56	24.87
	Σ							**24.3**	**56,094**	**25.64**	**10.88**
#13	1	0.240	500.00	5.00	0.4500	1.0000	2	45.2	93,826	64.30	29.51
	2	0.150	250.00	6.00	0.3100	0.4700	3	0.4	7,641	5.65	2.57
	3	0.290	100.00	6.40	0.4500	1.0000	2	10.7	53,728	36.82	18.11
	4	0.150	450.00	5.00	0.3100	0.4700	3	0.5	6,567	4.85	2.97
	5	0.240	250.00	5.00	0.3000	0.4500	4	2.2	13,681	8.80	4.27
	6	0.240	275.00	9.00	0.4500	0.4600	4	5.2	55,978	39.11	16.15
	Σ							**64.2**	**73,318**	**50.27**	**19.19**
#14	1	0.240	375.00	6.60	0.5500	0.4700	4	12.4	61,717	43.12	17.82
	2	0.240	385.00	8.00	0.6300	0.4700	4	7.7	46,217	28.60	15.10
	3	0.240	375.00	5.30	0.4900	0.6300	4	5.5	38,327	24.53	12.08
	Σ							**89.8**	**98,626**	**66.96**	**17.97**
#12	1	0.260	340.00	7.30	0.4500	1.0000	2	125.9	126,187	86.47	40.64
	2	0.150	250.00	6.00	0.3100	0.4700	3	0.2	7,290	5.39	2.45
	3	0.240	375.00	5.50	0.4800	0.5100	4	19.6	53,055	37.07	15.30
	4	0.240	400.00	6.40	0.4500	0.6900	4	8.3	69,563	48.60	20.12
	Σ							**154.0**	**99,183**	**68.21**	**30.77**
#10	1	0.290	650.00	7.00	0.4500	1.0000	2	85.4	168,832	115.70	54.71
	2	0.250	750.00	3.50	0.4500	1.0000	2	11.5	40,689	25.82	13.02
	Σ							**96.9**	**142,562**	**96.84**	**40.22**
#11	1	0.290	250.00	11.00	0.4500	1.0000	2	37.5	195,593	134.04	62.46
	2	0.150	500.00	6.00	0.3100	0.4700	3	0.5	10,885	8.05	3.66
	3	0.240	450.00	6.00	0.0530	0.4400	4	0.3	5,005	3.50	1.43
	4	0.240	475.00	5.00	0.6300	0.4500	4	6.2	35,604	22.48	11.38
	5	0.240	400.00	2.60	0.4500	1.0000	2	3.9	28,804	19.74	8.97
	Σ							**145.4**	**121,806**	**82.73**	**33.13**
#1	1	0.370	650.00	4.50	0.4500	1.0000	1	452.3	137,017	35.57	19.65
	2	0.370	800.00	3.00	0.4500	1.0000	1	633.3	78,397	11.44	6.17
	3	0.370	850.00	2.50	0.4500	1.0000	1	391.6	65,611	9.57	5.16
	Σ							**1,477.1**	**86,019**	**15.54**	**8.32**
#2	1	0.240	550.00	2.90	0.4900	0.6300	4	28.8	33,224	23.21	9.55

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	2	0.240	250.00	8.20	0.4500	1.0000	2	17.4	95,832	65.67	30.15
	3	0.355	350.00	7.00	0.4500	1.0000	1	644.3	159,109	21.76	11.83
	Σ							**2,313.0**	**103,515**	**21.70**	**10.80**
#3	1	0.320	190.00	10.00	0.4500	1.0000	1	35.5	128,519	33.37	17.62
	2	0.370	250.00	8.00	0.4500	1.0000	1	266.5	137,773	35.77	19.77
	Σ							**2,615.0**	**102,682**	**22.12**	**11.53**
#4	1	0.320	125.00	8.00	0.4500	1.0000	1	47.7	82,584	21.44	11.26
	2	0.370	315.00	6.30	0.4500	1.0000	1	214.5	122,434	31.79	17.54
	3	0.240	500.00	6.40	0.4500	0.6900	4	9.7	77,880	54.41	22.55
	Σ							**2,886.8**	**101,460**	**22.43**	**11.94**
#5	1	0.320	225.00	7.50	0.4500	1.0000	1	50.0	95,476	24.79	13.49
	2	0.240	320.00	8.00	0.5100	0.7200	4	39.7	103,274	72.15	30.04
	Σ							**3,130.5**	**102,214**	**25.60**	**13.38**
#6	1	0.370	360.00	8.30	0.4500	1.0000	1	820.0	188,469	19.04	10.50
	2	0.350	275.00	7.10	0.4500	1.0000	1	103.3	116,261	30.18	16.42
	3	0.240	500.00	6.00	0.4500	0.6900	4	14.5	77,023	53.81	22.30
	Σ							**4,068.0**	**111,723**	**24.80**	**13.17**
#7	1	0.240	300.00	5.40	0.4500	0.6900	4	3.6	48,834	34.12	14.07
	2	0.320	300.00	5.40	0.4500	1.0000	1	18.0	78,755	20.45	10.74
	3	0.240	525.00	3.80	0.4700	0.6700	4	17.3	39,426	27.54	11.34
	Σ							**4,196.6**	**108,988**	**25.53**	**13.35**
#8	1	0.333	440.00	8.20	0.4500	1.0000	1	572.2	184,917	22.08	12.07
	2	0.240	375.00	7.20	0.4500	0.6900	4	15.2	79,460	55.51	23.02
	3	0.320	600.00	6.40	0.4500	1.0000	1	122.8	147,976	38.42	20.33
	Σ							**4,906.1**	**115,962**	**25.84**	**13.44**
#9	1	0.365	375.00	7.00	0.4500	1.0000	1	556.1	160,140	41.58	22.77
	2	0.320	375.00	7.00	0.4500	1.0000	1	124.8	129,681	16.01	8.56
	Σ							**5,611.1**	**114,800**	**25.86**	**13.96**
#16	**Σ**							**5,611.1**	**114,800**	**25.86**	**13.96**
#17	**Σ**							**2,665.9**	**53,602**	**0.00**	**0.00**
#18	**Σ**							**1,515.9**	**37,643**	**0.00**	**0.00**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	4.71	30.00	636.28	4.370	0.040
		8. Large gullies, diversions, and low flowing streams	3.49	57.00	1,634.92	5.600	0.081
#1	**1**	**Time of Concentration:**					**0.121**
#1	2	7. Paved area and small upland gullies	8.78	70.00	796.90	5.960	0.037
		8. Large gullies, diversions, and low flowing streams	3.22	29.00	901.46	5.380	0.046
		9. Small streams flowing bankfull	1.86	69.00	3,706.88	12.270	0.083
#1	**2**	**Time of Concentration:**					**0.166**
#1	3	7. Paved area and small upland gullies	3.12	38.00	1,216.03	3.550	0.095
		8. Large gullies, diversions, and low flowing streams	2.38	28.00	1,177.90	4.620	0.070
#1	**3**	**Time of Concentration:**					**0.165**
#2	1	7. Paved area and small upland gullies	3.17	40.00	1,262.82	3.580	0.097
		9. Small streams flowing bankfull	3.12	32.00	1,025.90	15.890	0.017
#2	**1**	**Time of Concentration:**					**0.114**
#2	2	7. Paved area and small upland gullies	6.12	30.00	490.00	4.980	0.027
		9. Small streams flowing bankfull	2.58	17.00	660.01	14.440	0.012
#2	**2**	**Time of Concentration:**					**0.039**
#2	3	7. Paved area and small upland gullies	1.73	14.00	807.05	2.650	0.084
		8. Large gullies, diversions, and low flowing streams	3.19	29.00	908.12	5.360	0.047
		9. Small streams flowing bankfull	1.07	15.00	1,400.03	9.310	0.041
#2	**3**	**Time of Concentration:**					**0.172**
#3	1	7. Paved area and small upland gullies	7.32	43.00	587.07	5.440	0.029
		9. Small streams flowing bankfull	1.61	10.00	620.27	11.420	0.015
#3	**1**	**Time of Concentration:**					**0.044**
#3	2	7. Paved area and small upland gullies	2.34	15.00	640.64	3.080	0.057
		8. Large gullies, diversions, and low flowing streams	3.72	49.00	1,318.19	5.780	0.063
#3	**2**	**Time of Concentration:**					**0.120**
#4	1	7. Paved area and small upland gullies	9.60	60.00	625.00	6.230	0.027
		9. Small streams flowing bankfull	2.29	22.00	959.65	13.620	0.019
#4	**1**	**Time of Concentration:**					**0.046**
#4	2	7. Paved area and small upland gullies	4.66	14.00	300.11	4.340	0.019
		8. Large gullies, diversions, and low flowing streams	4.06	56.00	1,378.22	6.040	0.063

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	**2**	**Time of Concentration:**					**0.082**
#4	3	7. Paved area and small upland gullies	9.00	45.00	499.99	6.030	0.023
#4	**3**	**Time of Concentration:**					**0.023**
#5	1	7. Paved area and small upland gullies	10.69	82.00	766.79	6.580	0.032
		8. Large gullies, diversions, and low flowing streams	3.21	88.00	2,739.55	5.370	0.141
		9. Small streams flowing bankfull	2.10	72.00	3,420.75	13.050	0.072
#5	**1**	**Time of Concentration:**					**0.037**
#5	2	7. Paved area and small upland gullies	4.65	40.00	860.00	4.340	0.055
		9. Small streams flowing bankfull	3.04	41.00	1,350.01	15.680	0.023
#5	**2**	**Time of Concentration:**					**0.078**
#6	1	7. Paved area and small upland gullies	6.54	52.00	795.56	5.140	0.042
		9. Small streams flowing bankfull	1.11	13.00	1,174.34	9.460	0.034
#6	**1**	**Time of Concentration:**					**0.282**
#6	2	7. Paved area and small upland gullies	8.00	60.00	750.00	5.690	0.036
		9. Small streams flowing bankfull	1.87	22.00	1,174.33	12.310	0.026
#6	**2**	**Time of Concentration:**					**0.062**
#6	3	7. Paved area and small upland gullies	9.40	58.00	617.12	6.170	0.027
#6	**3**	**Time of Concentration:**					**0.027**
#7	1	7. Paved area and small upland gullies	4.99	30.00	601.66	4.490	0.037
		9. Small streams flowing bankfull	6.74	110.00	1,630.98	23.370	0.019
#7	**1**	**Time of Concentration:**					**0.100**
#7	3	7. Paved area and small upland gullies	5.87	50.00	851.98	4.870	0.048
		9. Small streams flowing bankfull	5.43	20.00	368.03	20.980	0.004
#7	**3**	**Time of Concentration:**					**0.052**
#8	1	7. Paved area and small upland gullies	4.21	34.00	807.08	4.130	0.054
		8. Large gullies, diversions, and low flowing streams	5.56	44.00	791.87	7.070	0.031
		9. Small streams flowing bankfull	0.94	15.00	1,591.17	8.730	0.050
#8	**1**	**Time of Concentration:**					**0.221**
#8	2	7. Paved area and small upland gullies	9.12	62.00	679.65	6.070	0.031
		8. Large gullies, diversions, and low flowing streams	5.65	34.00	602.23	7.120	0.023
		9. Small streams flowing bankfull	1.36	7.00	516.18	10.480	0.013
#8	**2**	**Time of Concentration:**					**0.067**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	3	7. Paved area and small upland gullies	8.33	75.00	900.00	5.810	0.043
		9. Small streams flowing bankfull	0.75	8.00	1,061.00	7.810	0.037
#8	**3**	**Time of Concentration:**					**0.080**
#9	1	7. Paved area and small upland gullies	7.32	45.00	615.00	5.440	0.031
		9. Small streams flowing bankfull	2.60	69.00	2,650.07	14.520	0.050
#9	**1**	**Time of Concentration:**					**0.081**
#9	2	7. Paved area and small upland gullies	3.64	42.00	1,154.32	3.830	0.083
		8. Large gullies, diversions, and low flowing streams	3.64	26.00	714.95	5.720	0.034
		9. Small streams flowing bankfull	1.91	8.00	418.23	12.440	0.009
#9	**2**	**Time of Concentration:**					**0.126**
#10	1	7. Paved area and small upland gullies	8.23	73.00	887.11	5.770	0.042
		8. Large gullies, diversions, and low flowing streams	5.22	30.00	575.14	6.850	0.023
#10	**1**	**Time of Concentration:**					**0.065**
#10	2	7. Paved area and small upland gullies	3.74	39.00	1,044.12	3.890	0.074
		6. Grassed waterway	1.00	8.82	882.00	1.500	0.163
#10	**2**	**Time of Concentration:**					**0.237**
#11	1	7. Paved area and small upland gullies	9.62	25.00	260.00	6.240	0.011
		9. Small streams flowing bankfull	4.53	26.00	573.95	19.150	0.008
#11	**1**	**Time of Concentration:**					**0.019**
#11	2	7. Paved area and small upland gullies	6.00	30.00	500.00	4.930	0.028
		9. Small streams flowing bankfull	1.77	10.00	566.34	11.950	0.013
#11	**2**	**Time of Concentration:**					**0.041**
#11	3	7. Paved area and small upland gullies	4.93	37.00	750.00	4.470	0.046
		9. Small streams flowing bankfull	1.39	4.00	288.43	10.590	0.007
#11	**3**	**Time of Concentration:**					**0.053**
#11	4	7. Paved area and small upland gullies	3.21	39.00	1,214.57	3.600	0.093
		6. Grassed waterway	1.00	11.40	1,140.00	1.500	0.211
#11	**4**	**Time of Concentration:**					**0.304**
#11	5	7. Paved area and small upland gullies	3.71	45.00	1,214.54	3.870	0.087
		9. Small streams flowing bankfull	1.00	11.40	1,140.00	9.000	0.035
#11	**5**	**Time of Concentration:**					**0.122**
#12	4	7. Paved area and small upland gullies	7.30	49.00	670.79	5.440	0.034
		6. Grassed waterway	1.00	2.50	250.00	1.500	0.046

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#12	**4**	**Time of Concentration:**					**0.080**
#13	1	7. Paved area and small upland gullies	4.96	30.00	605.00	4.480	0.037
		8. Large gullies, diversions, and low flowing streams	3.61	36.00	997.22	5.690	0.048
#13	**1**	**Time of Concentration:**					**0.085**
#13	2	7. Paved area and small upland gullies	6.00	15.00	250.00	4.930	0.014
		9. Small streams flowing bankfull	5.88	30.00	510.00	21.820	0.006
#13	**2**	**Time of Concentration:**					**0.020**
#13	3	7. Paved area and small upland gullies	4.00	10.00	250.00	4.020	0.017
#13	**3**	**Time of Concentration:**					**0.017**
#13	4	7. Paved area and small upland gullies	4.08	20.00	490.00	4.060	0.033
#13	**4**	**Time of Concentration:**					**0.033**
#13	5	7. Paved area and small upland gullies	4.40	22.00	500.00	4.220	0.032
		6. Grassed waterway	1.00	10.77	1,077.00	1.500	0.199
#13	**5**	**Time of Concentration:**					**0.231**
#13	6	7. Paved area and small upland gullies	8.27	31.00	375.00	5.780	0.018
		6. Grassed waterway	1.00	3.00	300.00	1.500	0.055
#13	**6**	**Time of Concentration:**					**0.073**
#14	1	7. Paved area and small upland gullies	5.60	35.00	625.00	4.760	0.036
#14	**1**	**Time of Concentration:**					**0.036**
#14	2	7. Paved area and small upland gullies	8.31	27.00	325.00	5.800	0.015
		6. Grassed waterway	1.00	20.16	2,016.00	1.500	0.373
#14	**2**	**Time of Concentration:**					**0.388**
#14	3	6. Grassed waterway	1.00	13.53	1,353.00	1.500	0.250
#14	**3**	**Time of Concentration:**					**0.250**
#15	4	7. Paved area and small upland gullies	10.67	40.00	375.00	6.570	0.015
		6. Grassed waterway	1.00	7.14	715.00	1.500	0.132
#15	**4**	**Time of Concentration:**					**0.147**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	9. Small streams flowing bankfull	1.94	91.00	4,701.50	12.520	0.104
#1	**1**	**Muskingum K:**					**0.104**
#2	1	9. Small streams flowing bankfull	2.99	20.00	669.47	15.550	0.011

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**1**	**Muskingum K:**					**0.011**
#4	3	7. Paved area and small upland gullies	8.00	20.00	250.00	5.690	0.012
#4	**3**	**Muskingum K:**					**0.012**
#6	3	7. Paved area and small upland gullies	6.67	20.00	300.00	5.190	0.016
#6	**3**	**Muskingum K:**					**0.016**
#8	2	9. Small streams flowing bankfull	0.75	8.00	1,061.00	7.810	0.037
#8	**2**	**Muskingum K:**					**0.037**
#11	1	9. Small streams flowing bankfull	1.64	14.00	854.80	11.510	0.020
#11	**1**	**Muskingum K:**					**0.020**
#11	2	9. Small streams flowing bankfull	1.39	4.00	288.43	10.590	0.007
#11	**2**	**Muskingum K:**					**0.007**
#13	1	9. Small streams flowing bankfull	3.60	36.00	998.86	17.080	0.016
#13	**1**	**Muskingum K:**					**0.016**
#13	3	7. Paved area and small upland gullies	4.57	36.00	787.43	4.300	0.050
		6. Grassed waterway	1.00	7.65	765.00	1.500	0.141
#13	**3**	**Muskingum K:**					**0.191**
#13	4	7. Paved area and small upland gullies	6.48	21.00	324.00	5.120	0.017
		6. Grassed waterway	1.00	7.65	765.00	1.500	0.141
#13	**4**	**Muskingum K:**					**0.158**

Appendix D: Exhibit D-3

SEDCAD 4.0 Output

for

Postmining Reclaimed Conditions, Proposed Subcategory

General Information

Storm Information:

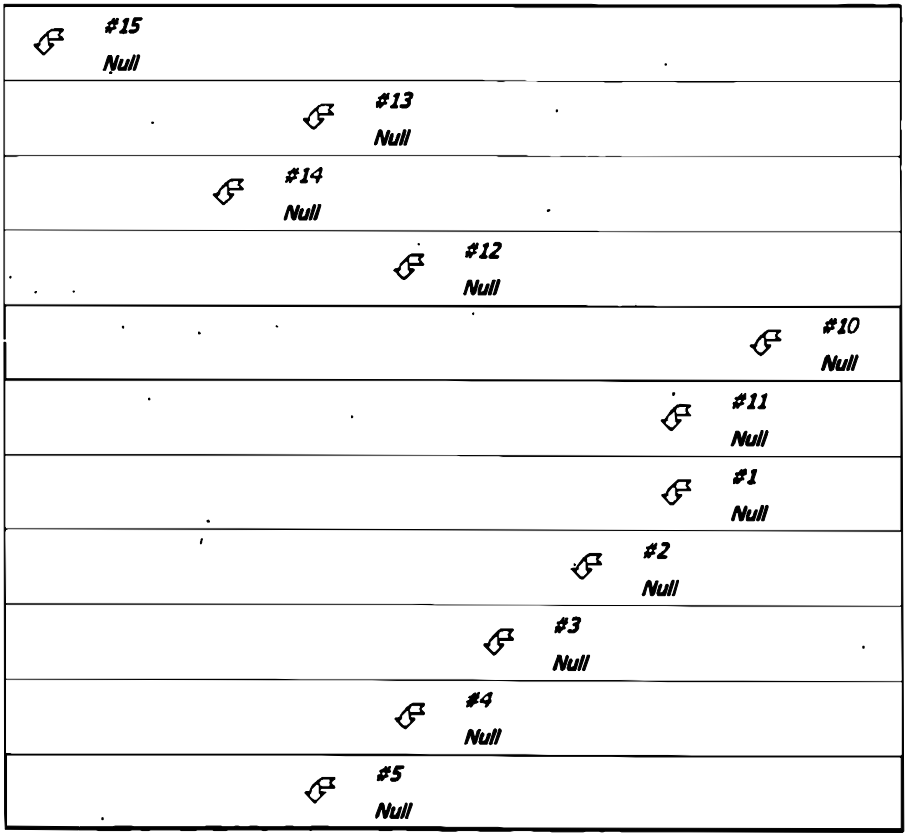
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

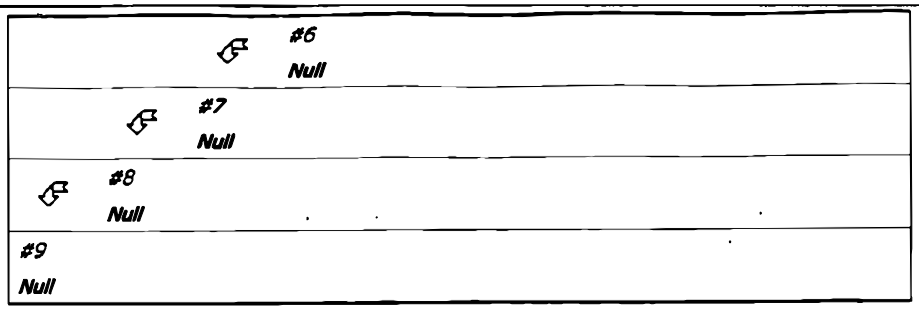
Particle Size Distribution:

Size (mm)	psd1	psd2	psd3	psd4
2.0000	100.000%	100.000%	60.000%	100.000%
0.1000	83.500%	30.000%	15.900%	26.500%
0.0500	77.000%	17.000%	8.400%	14.000%
0.0020	56.000%	11.000%	6.600%	11.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.050	0.429	Structure #2
Null	#2	==>	#3	0.018	0.435	Structure #3
Null	#3	==>	#4	0.029	0.433	Structure #3
Null	#4	==>	#5	0.011	0.445	Structure #4
Null	#5	==>	#6	0.057	0.414	Structure #5
Null	#6	==>	#7	0.023	0.428	Structure #6
Null	#7	==>	#8	0.060	0.419	Structure #7
Null	#8	==>	#9	0.048	0.397	Structure #8
Null	#9	==>	End	0.000	0.000	Structure #9
Null	#10	==>	#11	0.027	0.448	Structure #10
Null	#11	==>	#2	0.075	0.435	Structure #11
Null	#12	==>	#5	0.029	0.449	Structure #12
Null	#13	==>	#14	0.019	0.449	Structure #13
Null	#14	==>	#7	0.038	0.447	Structure #14
Null	#15	==>	#9	0.051	0.449	Structure #15





Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	9. Small streams flowing bankfull	1.30	24.00	1,847.57	10.25	0.050
#1	**Muskingum K:**					**0.050**
#2	9. Small streams flowing bankfull	1.60	12.00	751.55	11.37	0.018
#2	**Muskingum K:**					**0.018**
#3	9. Small streams flowing bankfull	1.47	17.00	1,153.01	10.92	0.029
#3	**Muskingum K:**					**0.029**
#4	9. Small streams flowing bankfull	2.38	14.00	587.93	13.88	0.011
#4	**Muskingum K:**					**0.011**
#5	9. Small streams flowing bankfull	0.83	14.00	1,686.68	8.19	0.057
#5	**Muskingum K:**					**0.057**
#6	9. Small streams flowing bankfull	1.27	11.00	866.89	10.13	0.023
#6	**Muskingum K:**					**0.023**
#7	9. Small streams flowing bankfull	0.95	18.00	1,900.33	8.75	0.060
#7	**Muskingum K:**					**0.060**
#8	9. Small streams flowing bankfull	0.53	6.00	1,139.38	6.53	0.048
#8	**Muskingum K:**					**0.048**
#10	9. Small streams flowing bankfull	2.66	38.00	1,428.73	14.67	0.027
#10	**Muskingum K:**					**0.027**
#11	9. Small streams flowing bankfull	1.58	49.00	3,097.14	11.32	0.075
#11	**Muskingum K:**					**0.075**
#12	9. Small streams flowing bankfull	2.80	45.00	1,609.09	15.05	0.029
#12	**Muskingum K:**					**0.029**
#13	9. Small streams flowing bankfull	2.79	30.00	1,076.50	15.02	0.019
#13	**Muskingum K:**					**0.019**
#14	9. Small streams flowing bankfull	2.52	50.00	1,981.84	14.29	0.038
#14	**Muskingum K:**					**0.038**
#15	9. Small streams flowing bankfull	2.82	79.00	2,798.44	15.12	0.051
#15	**Muskingum K:**					**0.051**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#15	33.912	33.912	7.52	0.78	24.3	56,094	25.64	10.88
#13	74.497	74.497	17.08	1.68	64.2	73,318	50.27	19.19
#14	41.522	116.019	23.22	2.59	89.8	98,626	66.96	17.97
#12	87.386	87.386	33.10	2.42	154.0	99,183	68.21	30.77
#10	35.153	35.153	13.16	1.26	96.9	142,562	96.84	40.22
#11	46.192	81.345	23.03	2.28	145.4	121,806	82.73	33.13
#1	288.818	288.818	244.26	27.26	1,477.1	86,019	15.54	8.32
#2	154.453	524.616	320.56	37.80	2,313.0	103,515	21.70	10.80
#3	31.628	556.244	354.80	40.64	2,615.0	102,682	22.12	11.53
#4	45.500	601.744	394.83	43.89	2,886.8	101,460	22.43	11.94
#5	38.578	727.708	445.51	47.66	3,130.5	102,214	25.60	13.38
#6	101.562	829.270	493.50	56.00	4,068.0	111,723	24.80	13.17
#7	46.416	991.705	522.07	59.81	4,196.6	108,988	25.53	13.35
#8	87.666	1,079.371	555.78	66.15	4,906.1	115,962	25.84	13.44
#9	75.240	1,188.523	601.89	72.93	5,611.1	114,800	25.86	13.96

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#15	1	3.038	0.100	0.065	0.378	93.000	M	3.42	0.287
	2	12.123	0.100	0.023	0.396	65.000	S	0.50	0.086
	3	8.741	0.100	0.000	0.000	74.000	M	2.61	0.190
	4	10.010	0.147	0.000	0.000	74.000	M	1.56	0.218
	Σ	**33.912**						**7.52**	**0.781**
#13	1	22.100	0.085	0.016	0.455	79.000	M	10.53	0.755
	2	10.547	0.020	0.000	0.000	65.000	S	0.43	0.075
	3	7.328	0.017	0.191	0.316	81.000	M	4.07	0.294
	4	13.158	0.033	0.158	0.301	65.000	S	0.54	0.094
	5	13.826	0.231	0.000	0.000	74.000	M	1.89	0.301
	6	7.538	0.073	0.000	0.000	74.000	M	2.25	0.164
	Σ	**74.497**						**17.08**	**1.683**
#14	1	16.221	0.036	0.000	0.000	74.000	M	4.85	0.353
	2	13.248	0.388	0.000	0.000	74.000	M	1.40	0.288
	3	12.053	0.250	0.000	0.000	74.000	M	1.59	0.262
	Σ	**116.019**						**23.22**	**2.586**
#12	1	40.766	0.116	0.048	0.442	80.000	M	21.01	1.511
	2	7.113	0.014	0.035	0.444	65.000	S	0.29	0.051
	3	29.932	0.057	0.000	0.000	74.000	M	8.94	0.651
	4	9.575	0.080	0.000	0.000	74.000	M	2.86	0.208
	Σ	**87.386**						**33.10**	**2.421**
#10	1	20.295	0.065	0.000	0.000	80.000	M	10.46	0.752
	2	14.858	0.237	0.000	0.000	79.000	M	3.68	0.507
	Σ	**35.153**						**13.16**	**1.259**
#11	1	8.414	0.019	0.020	0.436	79.000	M	4.01	0.287
	2	11.322	0.041	0.007	0.431	65.000	S	0.47	0.081
	3	5.500	0.053	0.000	0.000	74.000	M	1.64	0.120
	4	14.513	0.304	0.000	0.000	74.000	M	1.75	0.316
	5	6.443	0.122	0.000	0.000	79.000	M	3.07	0.220
	Σ	**81.345**						**23.03**	**2.283**
#1	1	44.593	0.121	0.104	0.440	93.000	M	50.25	4.209
	2	140.138	0.166	0.000	0.000	93.000	M	111.94	13.227
	3	104.087	0.165	0.000	0.000	93.000	M	83.14	9.824
	Σ	**288.818**						**244.26**	**27.260**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	70.798	0.114	0.011	0.451	74.000	M	21.15	1.541
	2	8.314	0.039	0.000	0.000	79.000	M	3.96	0.284
	3	75.341	0.172	0.000	0.000	91.500	M	54.68	6.433
	Σ	**524.616**						**320.56**	**37.800**
#3	1	5.514	0.044	0.000	0.000	88.000	M	4.81	0.371
	2	26.114	0.120	0.000	0.000	93.000	M	29.43	2.465
	Σ	**556.244**						**354.80**	**40.636**
#4	1	11.735	0.046	0.000	0.000	88.000	M	10.24	0.789
	2	23.800	0.082	0.000	0.000	93.000	M	26.82	2.246
	3	9.965	0.023	0.012	0.385	74.000	M	2.98	0.217
	Σ	**601.744**						**394.83**	**43.888**
#5	1	8.058	0.037	0.000	0.000	91.500	M	8.46	0.688
	2	30.520	0.078	0.000	0.000	74.000	M	9.12	0.664
	Σ	**727.708**						**445.51**	**47.662**
#6	1	72.562	0.282	0.000	0.000	93.000	M	51.41	6.849
	2	13.858	0.062	0.000	0.000	91.200	M	14.34	1.160
	3	15.142	0.027	0.016	0.377	74.000	M	4.52	0.330
	Σ	**829.270**						**493.50**	**55.999**
#7	1	5.974	0.100	0.000	0.000	74.000	M	1.78	0.130
	2	4.650	0.100	0.000	0.000	88.000	M	4.06	0.313
	3	35.792	0.052	0.000	0.000	74.000	M	10.69	0.779
	Σ	**991.705**						**522.07**	**59.807**
#8	1	55.900	0.221	0.000	0.000	91.900	M	39.48	4.903
	2	15.352	0.067	0.037	0.411	74.000	M	4.59	0.334
	3	16.414	0.080	0.000	0.000	88.000	M	14.32	1.104
	Σ	**1,079.371**						**555.78**	**66.148**
#9	1	51.950	0.081	0.000	0.000	91.500	M	54.54	4.436
	2	23.290	0.126	0.000	0.000	88.000	M	13.55	1.566
	Σ	**1,188.523**						**601.89**	**72.930**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#15	1	0.370	100.00	6.50	0.4500	1.0000	1	12.4	57,526	14.94	8.13
	2	0.150	450.00	6.00	0.3100	0.4700	3	0.6	10,413	7.70	3.50
	3	0.240	450.00	6.00	0.1800	0.4500	4	1.9	18,279	12.77	5.24
	4	0.240	475.00	9.00	0.6300	0.4700	4	9.3	80,383	52.56	24.87
	Σ							**24.3**	**56,094**	**25.64**	**10.88**
#13	1	0.240	500.00	5.00	0.4500	1.0000	2	45.2	93,826	64.30	29.51
	2	0.150	250.00	6.00	0.3100	0.4700	3	0.4	7,641	5.65	2.57
	3	0.290	100.00	6.40	0.4500	1.0000	2	10.7	53,728	36.82	18.11
	4	0.150	450.00	5.00	0.3100	0.4700	3	0.5	6,567	4.85	2.97
	5	0.240	250.00	5.00	0.3000	0.4500	4	2.2	13,681	8.80	4.27
	6	0.240	275.00	9.00	0.4500	0.4600	4	5.2	55,978	39.11	16.15
	Σ							**64.2**	**73,318**	**50.27**	**19.19**
#14	1	0.240	375.00	6.60	0.5500	0.4700	4	12.4	61,717	43.12	17.82
	2	0.240	385.00	8.00	0.6300	0.4700	4	7.7	46,217	28.60	15.10
	3	0.240	375.00	5.30	0.4900	0.6300	4	5.5	38,327	24.53	12.08
	Σ							**89.8**	**98,626**	**66.96**	**17.97**
#12	1	0.260	340.00	7.30	0.4500	1.0000	2	125.9	126,187	86.47	40.64
	2	0.150	250.00	6.00	0.3100	0.4700	3	0.2	7,290	5.39	2.45
	3	0.240	375.00	5.50	0.4800	0.5100	4	19.6	53,055	37.07	15.30
	4	0.240	400.00	6.40	0.4500	0.6900	4	8.3	69,563	48.60	20.12
	Σ							**154.0**	**99,183**	**68.21**	**30.77**
#10	1	0.290	650.00	7.00	0.4500	1.0000	2	85.4	168,832	115.70	54.71
	2	0.250	750.00	3.50	0.4500	1.0000	2	11.5	40,689	25.82	13.02
	Σ							**96.9**	**142,562**	**96.84**	**40.22**
#11	1	0.290	250.00	11.00	0.4500	1.0000	2	37.5	195,593	134.04	62.46
	2	0.150	500.00	6.00	0.3100	0.4700	3	0.5	10,885	8.05	3.66
	3	0.240	450.00	6.00	0.0530	0.4400	4	0.3	5,005	3.50	1.43
	4	0.240	475.00	5.00	0.6300	0.4500	4	6.2	35,604	22.48	11.38
	5	0.240	400.00	2.60	0.4500	1.0000	2	3.9	28,804	19.74	8.97
	Σ							**145.4**	**121,806**	**82.73**	**33.13**
#1	1	0.370	650.00	4.50	0.4500	1.0000	1	452.3	137,017	35.57	19.65
	2	0.370	800.00	3.00	0.4500	1.0000	1	633.3	78,397	11.44	6.17
	3	0.370	850.00	2.50	0.4500	1.0000	1	391.6	65,611	9.57	5.16
	Σ							**1,477.1**	**86,019**	**15.54**	**8.32**
#2	1	0.240	550.00	2.90	0.4900	0.6300	4	28.8	33,224	23.21	9.55
	2	0.240	250.00	8.20	0.4500	1.0000	2	17.4	95,832	65.67	30.15

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	3	0.355	350.00	7.00	0.4500	1.0000	1	644.3	159,109	21.76	11.83
	Σ							**2,313.0**	**103,515**	**21.70**	**10.80**
#3	1	0.320	190.00	10.00	0.4500	1.0000	1	35.5	128,519	33.37	17.62
	2	0.370	250.00	8.00	0.4500	1.0000	1	266.5	137,773	35.77	19.77
	Σ							**2,615.0**	**102,682**	**22.12**	**11.53**
#4	1	0.320	125.00	8.00	0.4500	1.0000	1	47.7	82,584	21.44	11.26
	2	0.370	315.00	6.30	0.4500	1.0000	1	214.5	122,434	31.79	17.54
	3	0.240	500.00	6.40	0.4500	0.6900	4	9.7	77,880	54.41	22.55
	Σ							**2,886.8**	**101,460**	**22.43**	**11.94**
#5	1	0.320	225.00	7.50	0.4500	1.0000	1	50.0	95,476	24.79	13.49
	2	0.240	320.00	8.00	0.5100	0.7200	4	39.7	103,274	72.15	30.04
	Σ							**3,130.5**	**102,214**	**25.60**	**13.38**
#6	1	0.370	360.00	8.30	0.4500	1.0000	1	820.0	188,469	19.04	10.50
	2	0.350	275.00	7.10	0.4500	1.0000	1	103.3	116,261	30.18	16.42
	3	0.240	500.00	6.00	0.4500	0.6900	4	14.5	77,023	53.81	22.30
	Σ							**4,068.0**	**111,723**	**24.80**	**13.17**
#7	1	0.240	300.00	5.40	0.4500	0.6900	4	3.6	48,834	34.12	14.07
	2	0.320	300.00	5.40	0.4500	1.0000	1	18.0	78,755	20.45	10.74
	3	0.240	525.00	3.80	0.4700	0.6700	4	17.3	39,426	27.54	11.34
	Σ							**4,196.6**	**108,988**	**25.53**	**13.35**
#8	1	0.333	440.00	8.20	0.4500	1.0000	1	572.2	184,917	22.08	12.07
	2	0.240	375.00	7.20	0.4500	0.6900	4	15.2	79,460	55.51	23.02
	3	0.320	600.00	6.40	0.4500	1.0000	1	122.8	147,976	38.42	20.33
	Σ							**4,906.1**	**115,962**	**25.84**	**13.44**
#9	1	0.365	375.00	7.00	0.4500	1.0000	1	556.1	160,140	41.58	22.77
	2	0.320	375.00	7.00	0.4500	1.0000	1	124.8	129,681	16.01	8.56
	Σ							**5,611.1**	**114,800**	**25.86**	**13.96**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	4.71	30.00	636.28	4.370	0.040
		8. Large gullies, diversions, and low flowing streams	3.49	57.00	1,634.92	5.600	0.081

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	**1**	**Time of Concentration:**					**0.121**
#1	2	7. Paved area and small upland gullies	8.78	70.00	796.90	5.960	0.037
		8. Large gullies, diversions, and low flowing streams	3.22	29.00	901.46	5.380	0.046
		9. Small streams flowing bankfull	1.86	69.00	3,706.88	12.270	0.083
#1	**2**	**Time of Concentration:**					**0.166**
#1	3	7. Paved area and small upland gullies	3.12	38.00	1,216.03	3.550	0.095
		8. Large gullies, diversions, and low flowing streams	2.38	28.00	1,177.90	4.620	0.070
#1	**3**	**Time of Concentration:**					**0.165**
#2	1	7. Paved area and small upland gullies	3.17	40.00	1,262.82	3.580	0.097
		9. Small streams flowing bankfull	3.12	32.00	1,025.90	15.890	0.017
#2	**1**	**Time of Concentration:**					**0.114**
#2	2	7. Paved area and small upland gullies	6.12	30.00	490.00	4.980	0.027
		9. Small streams flowing bankfull	2.58	17.00	660.01	14.440	0.012
#2	**2**	**Time of Concentration:**					**0.039**
#2	3	7. Paved area and small upland gullies	1.73	14.00	807.05	2.650	0.084
		8. Large gullies, diversions, and low flowing streams	3.19	29.00	908.12	5.360	0.047
		9. Small streams flowing bankfull	1.07	15.00	1,400.03	9.310	0.041
#2	**3**	**Time of Concentration:**					**0.172**
#3	1	7. Paved area and small upland gullies	7.32	43.00	587.07	5.440	0.029
		9. Small streams flowing bankfull	1.61	10.00	620.27	11.420	0.015
#3	**1**	**Time of Concentration:**					**0.044**
#3	2	7. Paved area and small upland gullies	2.34	15.00	640.64	3.080	0.057
		8. Large gullies, diversions, and low flowing streams	3.72	49.00	1,318.19	5.780	0.063
#3	**2**	**Time of Concentration:**					**0.120**
#4	1	7. Paved area and small upland gullies	9.60	60.00	625.00	6.230	0.027
		9. Small streams flowing bankfull	2.29	22.00	959.65	13.620	0.019
#4	**1**	**Time of Concentration:**					**0.046**
#4	2	7. Paved area and small upland gullies	4.66	14.00	300.11	4.340	0.019
		8. Large gullies, diversions, and low flowing streams	4.06	56.00	1,378.22	6.040	0.063
#4	**2**	**Time of Concentration:**					**0.082**
#4	3	7. Paved area and small upland gullies	9.00	45.00	499.99	6.030	0.023
#4	**3**	**Time of Concentration:**					**0.023**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	7. Paved area and small upland gullies	10.69	82.00	766.79	6.580	0.032
		8. Large gullies, diversions, and low flowing streams	3.21	88.00	2,739.55	5.370	0.141
		9. Small streams flowing bankfull	2.10	72.00	3,420.75	13.050	0.072
#5	**1**	**Time of Concentration:**					**0.037**
#5	2	7. Paved area and small upland gullies	4.65	40.00	860.00	4.340	0.055
		9. Small streams flowing bankfull	3.04	41.00	1,350.01	15.680	0.023
#5	**2**	**Time of Concentration:**					**0.078**
#6	1	7. Paved area and small upland gullies	6.54	52.00	795.56	5.140	0.042
		9. Small streams flowing bankfull	1.11	13.00	1,174.34	9.460	0.034
#6	**1**	**Time of Concentration:**					**0.282**
#6	2	7. Paved area and small upland gullies	8.00	60.00	750.00	5.690	0.036
		9. Small streams flowing bankfull	1.87	22.00	1,174.33	12.310	0.026
#6	**2**	**Time of Concentration:**					**0.062**
#6	3	7. Paved area and small upland gullies	9.40	58.00	617.12	6.170	0.027
#6	**3**	**Time of Concentration:**					**0.027**
#7	1	7. Paved area and small upland gullies	4.99	30.00	601.66	4.490	0.037
		9. Small streams flowing bankfull	6.74	110.00	1,630.98	23.370	0.019
#7	**1**	**Time of Concentration:**					**0.100**
#7	3	7. Paved area and small upland gullies	5.87	50.00	851.98	4.870	0.048
		9. Small streams flowing bankfull	5.43	20.00	368.03	20.980	0.004
#7	**3**	**Time of Concentration:**					**0.052**
#8	1	7. Paved area and small upland gullies	4.21	34.00	807.08	4.130	0.054
		8. Large gullies, diversions, and low flowing streams	5.56	44.00	791.87	7.070	0.031
		9. Small streams flowing bankfull	0.94	15.00	1,591.17	8.730	0.050
#8	**1**	**Time of Concentration:**					**0.221**
#8	2	7. Paved area and small upland gullies	9.12	62.00	679.65	6.070	0.031
		8. Large gullies, diversions, and low flowing streams	5.65	34.00	602.23	7.120	0.023
		9. Small streams flowing bankfull	1.36	7.00	516.18	10.480	0.013
#8	**2**	**Time of Concentration:**					**0.067**
#8	3	7. Paved area and small upland gullies	8.33	75.00	900.00	5.810	0.043
		9. Small streams flowing bankfull	0.75	8.00	1,061.00	7.810	0.037
#8	**3**	**Time of Concentration:**					**0.080**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	7. Paved area and small upland gullies	7.32	45.00	615.00	5.440	0.031
		9. Small streams flowing bankfull	2.60	69.00	2,650.07	14.520	0.050
#9	**1**	**Time of Concentration:**					**0.081**
#9	2	7. Paved area and small upland gullies	3.64	42.00	1,154.32	3.830	0.083
		8. Large gullies, diversions, and low flowing streams	3.64	26.00	714.95	5.720	0.034
		9. Small streams flowing bankfull	1.91	8.00	418.23	12.440	0.009
#9	**2**	**Time of Concentration:**					**0.126**
#10	1	7. Paved area and small upland gullies	8.23	73.00	887.11	5.770	0.042
		8. Large gullies, diversions, and low flowing streams	5.22	30.00	575.14	6.850	0.023
#10	**1**	**Time of Concentration:**					**0.065**
#10	2	7. Paved area and small upland gullies	3.74	39.00	1,044.12	3.890	0.074
		6. Grassed waterway	1.00	8.82	882.00	1.500	0.163
#10	**2**	**Time of Concentration:**					**0.237**
#11	1	7. Paved area and small upland gullies	9.62	25.00	260.00	6.240	0.011
		9. Small streams flowing bankfull	4.53	26.00	573.95	19.150	0.008
#11	**1**	**Time of Concentration:**					**0.019**
#11	2	7. Paved area and small upland gullies	6.00	30.00	500.00	4.930	0.028
		9. Small streams flowing bankfull	1.77	10.00	566.34	11.950	0.013
#11	**2**	**Time of Concentration:**					**0.041**
#11	3	7. Paved area and small upland gullies	4.93	37.00	750.00	4.470	0.046
		9. Small streams flowing bankfull	1.39	4.00	288.43	10.590	0.007
#11	**3**	**Time of Concentration:**					**0.053**
#11	4	7. Paved area and small upland gullies	3.21	39.00	1,214.57	3.600	0.093
		6. Grassed waterway	1.00	11.40	1,140.00	1.500	0.211
#11	**4**	**Time of Concentration:**					**0.304**
#11	5	7. Paved area and small upland gullies	3.71	45.00	1,214.54	3.870	0.087
		9. Small streams flowing bankfull	1.00	11.40	1,140.00	9.000	0.035
#11	**5**	**Time of Concentration:**					**0.122**
#12	4	7. Paved area and small upland gullies	7.30	49.00	670.79	5.440	0.034
		6. Grassed waterway	1.00	2.50	250.00	1.500	0.046
#12	**4**	**Time of Concentration:**					**0.080**
#13	1	7. Paved area and small upland gullies	4.96	30.00	605.00	4.480	0.037

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.61	36.00	997.22	5.690	0.048
#13	**1**	**Time of Concentration:**					**0.085**
#13	2	7. Paved area and small upland gullies	6.00	15.00	250.00	4.930	0.014
		9. Small streams flowing bankfull	5.88	30.00	510.00	21.820	0.006
#13	**2**	**Time of Concentration:**					**0.020**
#13	3	7. Paved area and small upland gullies	4.00	10.00	250.00	4.020	0.017
#13	**3**	**Time of Concentration:**					**0.017**
#13	4	7. Paved area and small upland gullies	4.08	20.00	490.00	4.060	0.033
#13	**4**	**Time of Concentration:**					**0.033**
#13	5	7. Paved area and small upland gullies	4.40	22.00	500.00	4.220	0.032
		6. Grassed waterway	1.00	10.77	1,077.00	1.500	0.199
#13	**5**	**Time of Concentration:**					**0.231**
#13	6	7. Paved area and small upland gullies	8.27	31.00	375.00	5.780	0.018
		6. Grassed waterway	1.00	3.00	300.00	1.500	0.055
#13	**6**	**Time of Concentration:**					**0.073**
#14	1	7. Paved area and small upland gullies	5.60	35.00	625.00	4.760	0.036
#14	**1**	**Time of Concentration:**					**0.036**
#14	2	7. Paved area and small upland gullies	8.31	27.00	325.00	5.800	0.015
		6. Grassed waterway	1.00	20.16	2,016.00	1.500	0.373
#14	**2**	**Time of Concentration:**					**0.388**
#14	3	6. Grassed waterway	1.00	13.53	1,353.00	1.500	0.250
#14	**3**	**Time of Concentration:**					**0.250**
#15	4	7. Paved area and small upland gullies	10.67	40.00	375.00	6.570	0.015
		6. Grassed waterway	1.00	7.14	715.00	1.500	0.132
#15	**4**	**Time of Concentration:**					**0.147**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	9. Small streams flowing bankfull	1.94	91.00	4,701.50	12.520	0.104
#1	**1**	**Muskingum K:**					**0.104**
#2	1	9. Small streams flowing bankfull	2.99	20.00	669.47	15.550	0.011
#2	**1**	**Muskingum K:**					**0.011**
#4	3	7. Paved area and small upland gullies	8.00	20.00	250.00	5.690	0.012

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	**3**	**Muskingum K:**					**0.012**
#6	3	7. Paved area and small upland gullies	6.67	20.00	300.00	5.190	0.016
#6	**3**	**Muskingum K:**					**0.016**
#8	2	9. Small streams flowing bankfull	0.75	8.00	1,061.00	7.810	0.037
#8	**2**	**Muskingum K:**					**0.037**
#11	1	9. Small streams flowing bankfull	1.64	14.00	854.80	11.510	0,020
#11	**1**	**Muskingum K:**					**0.020**
#11	2	9. Small streams flowing bankfull	1.39	4.00	288.43	10.590	0.007
#11	**2**	**Muskingum K:**					**0.007**
#13	1	9. Small streams flowing bankfull	3.60	36.00	998.86	17.080	0.016
#13	**1**	**Muskingum K:**					**0.016**
#13	3	7. Paved area and small upland gullies	4.57	36.00	787.43	4.300	0.050
		6. Grassed waterway	1.00	7.65	765.00	1.500	0.141
#13	**3**	**Muskingum K:**					**0.191**
#13	4	7. Paved area and small upland gullies	6.48	21.00	324.00	5.120	0.017
		6. Grassed waterway	1.00	7.65	765.00	1.500	0.141
#13	**4**	**Muskingum K:**					**0.158**

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,616.50	5.671	16.855	0.000		
4,617.00	6.216	19.825	0.000		
4,617.50	6.784	23.074	0.000		
4,618.00	7.378	26.613	0.000		
4,618.50	7.996	30.456	0.000		
4,619.00	8.639	34.613	0.000		
4,619.50	9.307	39.099	0.000		
4,620.00	10.000	43.924	0.000		
4,620.50	10.122	48.955	0.000		
4,621.00	10.246	54.047	0.000		Spillway #1
4,621.50	10.369	59.201	5.419	11.51*	
4,621.58	10.389	59.987	15.354	1.30	Peak Stage
4,622.00	10.494	64.417	71.329		
4,622.50	10.619	69.695	145.356		
4,623.00	10.746	75.036	241.897		
4,623.50	10.872	80.441	356.760		
4,624.00	11.000	85.909	489.149		
4,624.50	11.128	91.441	638.637		
4,625.00	11.257	97.037	805.005		
4,625.50	11.387	102.698	988.163		
4,626.00	11.518	108.424	1,188.108		
4,626.50	11.649	114.216	1,404.895		
4,627.00	11.781	120.073	1,638.623		
4,627.50	11.914	125.997	1,889.420		
4,628.00	12.047	131.987	2,157.436		
4,628.50	12.182	138.045	2,442.839		
4,629.00	12.317	144.169	2,745.811		
4,629.50	12.453	150.362	3,066.542		
4,630.00	12.589	156.622	3,405.229		
4,630.50	12.726	162.951	3,762.076		
4,631.00	12.864	169.349	4,137.291		
4,631.50	13.003	175.815	4,531.083		
4,632.00	13.143	182.352	4,943.667		
4,632.50	13.283	188.958	5,375.254		
4,633.00	13.424	195.635	5,826.061		
4,633.50	13.566	202.382	6,296.302		
4,634.00	13.708	209.201	6,786.193		
4,634.50	13.851	216.090	7,295.949		
4,635.00	13.995	223.052	7,825.783		
4,635.50	14.140	230.086	8,375.908		
4,636.00	14.285	237.192	8,946.538		

The average annual sediment yield numbers presented in Table 6b, in Section 6, were calculated by using the pond design feature in SEDCAD 4.0. By putting a fictitious pond at the bottom of the model, SEDCAD will calculate the amount of sediment storage needed to store the sediment yield. The fictitious pond structure details along with the estimate of the sediment storage is presented on the following pages.

Structure Detail:

Structure #16 (Pond)

Pond Inputs:

Initial Pool Elev:	4,611.68
Initial Pool:	0.00 ac-ft
*Sediment Storage:	6.64 ac-ft
Dead Space:	20.00 %

**Sediment capacity based on Average Annual R of 30.0 for 1 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,621.00	20.00	2.00:1	2.00:1	30.00

Pond Results:

Peak Elevation:	4,621.58
H'graph Detention Time:	13.67 hrs
Pond Model:	CSTRS
Dewater Time:	0.53 days
Trap Efficiency:	100.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,611.68	1.706	0.000	0.000		Top of Sed. Storage
4,611.68	1.706	0.002	0.000		
4,612.00	1.898	0.579	0.000		
4,612.50	2.218	1.606	0.000		
4,613.00	2.563	2.800	0.000		
4,613.50	2.932	4.173	0.000		
4,614.00	3.327	5.737	0.000		
4,614.50	3.746	7.504	0.000		
4,615.00	4.190	9.486	0.000		
4,615.50	4.659	11.698	0.000		
4,616.00	5.153	14.149	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
4,636.50	14.432	244.371	9,537.884	
4,637.00	14.579	251.624	10,150.150	
4,637.50	14.726	258.950	10,783.560	
4,638.00	14.875	266.350	11,438.300	
4,638.50	15.024	273.825	12,114.600	
4,639.00	15.174	281.374	12,812.640	
4,639.50	15.324	288.999	13,532.630	
4,640.00	15.476	296.699	14,274.780	
4,640.50	15.628	304.475	15,039.290	
4,641.00	15.781	312.327	15,826.340	
4,641.50	15.935	320.256	16,636.150	
4,642.00	16.089	328.261	17,468.890	
4,642.50	16.244	336.345	18,324.770	
4,643.00	16.400	344.506	19,203.970	
4,643.50	16.557	352.745	20,106.690	
4,644.00	16.714	361.062	21,033.100	
4,644.50	16.872	369.459	21,983.410	
4,645.00	17.031	377.934	22,957.790	
4,645.50	17.190	386.490	23,956.420	
4,646.00	17.351	395.125	24,979.490	
4,646.50	17.512	403.841	26,027.170	
4,647.00	17.674	412.637	27,099.650	
4,647.50	17.836	421.514	28,197.100	
4,648.00	18.000	430.473	29,319.690	
4,648.50	18.164	439.514	30,467.600	
4,649.00	18.328	448.637	31,640.990	
4,649.50	18.494	457.843	32,840.050	
4,650.00	18.660	467.131	34,064.930	
4,650.50	18.827	476.503	35,315.820	
4,651.00	18.995	485.959	36,592.860	
4,651.50	19.164	495.498	37,896.230	
4,652.00	19.333	505.122	39,226.080	
4,652.50	19.503	514.831	40,582.590	
4,653.00	19.674	524.625	41,965.910	
4,653.50	19.845	534.505	43,376.200	
4,654.00	20.017	544.471	44,813.610	
4,654.50	20.190	554.523	46,278.320	
4,655.00	20.364	564.661	47,770.450	
4,655.50	20.539	574.887	49,290.190	
4,656.00	20.714	585.200	50,837.670	
4,656.50	20.890	595.601	52,413.040	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
4,657.00	21.067	606.090	54,016.470	
4,657.50	21.244	616.668	55,648.090	
4,658.00	21.422	627.334	57,308.060	
4,658.50	21.601	638.090	58,996.510	
4,659.00	21.781	648.935	60,713.600	
4,659.50	21.961	659.871	62,459.480	
4,660.00	22.143	670.897	64,234.280	
4,660.50	22.324	682.014	66,038.150	
4,661.00	22.507	693.222	67,871.220	
4,661.50	22.691	704.521	69,733.650	
4,662.00	22.875	715.912	71,625.560	
4,662.50	23.060	727.396	73,547.090	
4,663.00	23.245	738.972	75,498.400	
4,663.50	23.432	750.641	77,479.600	
4,664.00	23.619	762.404	79,490.840	
4,664.50	23.807	774.260	81,532.250	
4,665.00	23.995	786.210	83,603.950	
4,665.50	24.185	798.255	85,706.100	
4,666.00	24.375	810.395	87,838.810	
4,666.50	24.566	822.630	90,002.230	
4,667.00	24.757	834.961	92,196.470	
4,667.50	24.950	847.388	94,421.660	
4,668.00	25.143	859.911	96,677.950	
4,668.50	25.336	872.530	98,965.440	
4,669.00	25.531	885.247	101,284.300	
4,669.50	25.726	898.061	103,634.600	
4,670.00	25.922	910.974	106,016.500	
4,670.50	26.119	923.984	108,430.100	
4,671.00	26.317	937.093	110,875.500	
4,671.50	26.515	950.301	113,352.900	
4,672.00	26.714	963.608	115,862.400	
4,672.50	26.914	977.015	118,404.000	
4,673.00	27.114	990.522	120,978.100	
4,673.50	27.316	1004.130	123,584.500	
4,674.00	27.518	1017.838	126,223.500	
4,674.50	27.721	1031.647	128,895.200	
4,675.00	27.924	1045.559	131,599.700	
4,675.50	28.128	1059.572	134,337.100	
4,676.00	28.333	1073.687	137,107.500	
4,676.50	28.539	1087.905	139,911.100	
4,677.00	28.746	1102.226	142,748.000	

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,624.00	489.149	489.149
4,624.50	638.637	638.637
4,625.00	805.005	805.005
4,625.50	988.163	988.163
4,626.00	1,188.108	1,188.108
4,626.50	1,404.895	1,404.895
4,627.00	1,638.623	1,638.623
4,627.50	1,889.420	1,889.420
4,628.00	2,157.436	2,157.436
4,628.50	2,442.839	2,442.839
4,629.00	2,745.811	2,745.811
4,629.50	3,066.542	3,066.542
4,630.00	3,405.229	3,405.229
4,630.50	3,762.076	3,762.076
4,631.00	4,137.291	4,137.291
4,631.50	4,531.083	4,531.083
4,632.00	4,943.667	4,943.667
4,632.50	5,375.254	5,375.254
4,633.00	5,826.061	5,826.061
4,633.50	6,296.302	6,296.302
4,634.00	6,786.193	6,786.193
4,634.50	7,295.949	7,295.949
4,635.00	7,825.783	7,825.783
4,635.50	8,375.908	8,375.908
4,636.00	8,946.538	8,946.538
4,636.50	9,537.884	9,537.884
4,637.00	10,150.150	10,150.150
4,637.50	10,783.560	10,783.560
4,638.00	11,438.300	11,438.300
4,638.50	12,114.600	12,114.600
4,639.00	12,812.640	12,812.640
4,639.50	13,532.630	13,532.630
4,640.00	14,274.780	14,274.780
4,640.50	15,039.290	15,039.290
4,641.00	15,826.340	15,826.340
4,641.50	16,636.150	16,636.150
4,642.00	17,468.890	17,468.890
4,642.50	18,324.770	18,324.770
4,643.00	19,203.970	19,203.970

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,643.50	20,106.690	20,106.690
4,644.00	21,033.100	21,033.100
4,644.50	21,983.410	21,983.410
4,645.00	22,957.790	22,957.790
4,645.50	23,956.420	23,956.420
4,646.00	24,979.490	24,979.490
4,646.50	26,027.170	26,027.170
4,647.00	27,099.650	27,099.650
4,647.50	28,197.100	28,197.100
4,648.00	29,319.690	29,319.690
4,648.50	30,467.600	30,467.600
4,649.00	31,640.990	31,640.990
4,649.50	32,840.050	32,840.050
4,650.00	34,064.930	34,064.930
4,650.50	35,315.820	35,315.820
4,651.00	36,592.860	36,592.860
4,651.50	37,896.230	37,896.230
4,652.00	39,226.080	39,226.080
4,652.50	40,582.590	40,582.590
4,653.00	41,965.910	41,965.910
4,653.50	43,376.200	43,376.200
4,654.00	44,813.610	44,813.610
4,654.50	46,278.320	46,278.320
4,655.00	47,770.450	47,770.450
4,655.50	49,290.190	49,290.190
4,656.00	50,837.670	50,837.670
4,656.50	52,413.040	52,413.040
4,657.00	54,016.470	54,016.470
4,657.50	55,648.090	55,648.090
4,658.00	57,308.060	57,308.060
4,658.50	58,996.510	58,996.510
4,659.00	60,713.600	60,713.600
4,659.50	62,459.480	62,459.480
4,660.00	64,234.280	64,234.280
4,660.50	66,038.150	66,038.150
4,661.00	67,871.220	67,871.220
4,661.50	69,733.650	69,733.650
4,662.00	71,625.560	71,625.560
4,662.50	73,547.090	73,547.090